Learning Advanced Skills on New Instruments

(or: Practising Scales and Arpeggios on Your NIME)

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ABSTRACT

When learning a classical instrument, people often either take lessons in which an existing body of "technique" is delivered, evolved over generations of performers, or in some cases people will "teach themselves" by watching people play and listening to existing recordings. What does one do with a complex new digital instrument?

In this paper I address this question drawing on my experience in learning several very different types of sophisticated instruments: the *Glove Talk II* real-time gesture-to-speech interface, the *Digital Marionette* controller for virtual 3D puppets, and pianos and keyboards. As the primary user of the first two systems, I have spent hundreds of hours with *Digital Marionette* and *Glove-Talk II*, and thousands of hours with pianos and keyboards (I continue to work as a professional musician). I will identify some of the underlying principles and approaches that I have observed during my learning and playing experience common to these instruments. While typical accounts of users learning new interfaces generally focus on reporting beginner's experiences, for various practical reasons, this is fundamentally different by focusing on the expert's learning experience.

Keywords

performance, learning new instruments

1. INTRODUCTION

While there is a quickly growing number of experimental new instruments being prototyped and designed, the number of skilled performers, let alone virtuosi, may not be growing at the same rate. Prototyping an instrument can, in some cases, happen in a relatively short concentrated time, while mastering performance with it, almost by definition, requires a certain time commitment of practise. Yet if an instrument were designed to be "easy-to-master", it would quite possibly not be that interesting to play or to listen to more than a few times once the novelty wears off. These issues and trade-offs are discussed in depth in the literature[5, 3, 14, 6, 13, 15].

When learning a classical instrument, many people either take lessons in which an existing body of "technique" is delivered, evolved over generations of performers, or in some cases (more with an instrument such as a guitar or piano than, say, trumpet) people will "teach themselves by ear". What does one do with a complex new digital instrument?

In this paper I address this question drawing on my experience in learning several very different types of sophisticated instruments: the *Glove Talk II* real-time gesture-to-speech interface[4], the *Digital Marionette* interface for controlling virtual 3D puppets[9] (not a musical interface per se, but a high-degree-of-freedom continuous controller for expressive output), and pianos and keyboards. As a user, I have spent hundreds of hours with each of *Digital Marionette* and *Glove-Talk II*, and thousands of hours with pianos and keyboards, and continue to work as a professional musician. I will identify some of the underlying principles and approaches that I have observed during my learning and playing experience. While typical accounts of learning to use new interfaces focus on reporting beginner's experiences, for various practical reasons, this one is fundamentally different by focusing on the expert's learning experience.

Most of the examples discussed in this paper can be demonstrated either in existing video clips or in live performance.

2. LEARNING PROCESS

As this is based on a single user's extensive experience with specific instruments, I will first briefly describe the instruments themselves and the learning processes for each of them.

2.1 Glove Talk II

Glove Talk II[4] used neural networks to map hand gestures, acquired via glove sensors and motion trackers, to allow the user ("speaker") to create speech in real-time. One glove measured joint angles of the fingers to determine whether the hand was open (to create vowel sounds) or closed (to create consonants). Movement of the hand in a (2D) horizontal plane corresponded to trajectories through a continuous vowel space, vertical motion corresponded to pitch, and different hand gestures corresponded to a variety of consonant sounds. A second glove, built with contact sensors, triggered additional consonant sounds (the "stop" consonants), and a foot pedal allowed volume control. Figure 1 shows a schematic illustration of the system. In order

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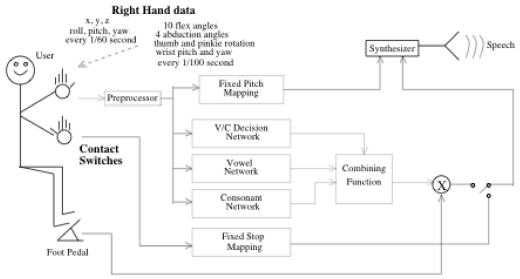

Figure 1: The *GloveTalk II* system. (Figure by Sid Fels reproduced with permission).

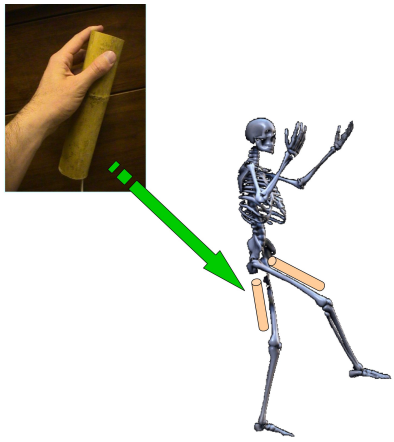

Figure 2: The *Digital Marionette* system provides the user with a tangible interface for interactive control of a 3D articulated character.

to produce intelligible speech, accurate timing between the two hands was critical, as was very accurate motion through a 3-dimensional "fretless" space of vowels and pitch[1].

I logged 100 hours learning and using the system. Fels [4] accurately described my learning experience with GTII as a sequence of phases corresponding to (a) phoneme production, (b) 2-phonemes, (c) words, (d) phrases, (e) refinement; pointing out that there was substantial overlap between phases.

The first four of these phases correspond to a time-based hierarchical breakdown of the speech task itself. In Section 6, I take a complementary approach by discussing the general principles driving the learning process, which also motivates the above breakdown.

2.2 Digital Marionette

Digital Marionette[9] is a two-handed instrument for interactive character animation. The user ("puppeteer") is provided with two motion trackers embedded in bamboo tubing to control a virtual puppets motion. A multi-track interface is used, controlling layers of the puppet motion (e.g. legs, arms, spine, etc) in multiple passes. A maximum of six degrees of freedom (position and orientation) for each of the two trackers is available for manipulating the various continuous parameters (joint angles) for animating each layer[2].

On the order of 100 hours were spent learning this instrument, although this is an approximate figure since time was also spent learning early versions of the system during an iterative development process.

2.3 Pianos and Keyboards

I studied classical piano formally from age 7 through undergraduate university, and studied jazz after that. Presumably, this learning experience strongly influenced the choices I made when learning instruments such as *Glove Talk II* and *Digital Marionette*. An essential element of the learning process has been (and continues to be) improvised and scored performances, both as a soloist and with other artists (symphony orchestras, percussionists, singers, DJ's, dancers and others) as well as professional recording sessions. It was only well after university that I understood playing electric keyboards as a different skill from playing pianos– the primary similarity is in the front-end of the interface, but this seems to be a deceptively overshadowing one for many people (for good reasons).

3. ANALYZING THE EXPERIENCE

The expressiveness of an instruments implies a wide range of possible ways of using it, which in turn implies a corresponding range of choices during learning. These choices are driven by a user's goals, learning style, and individual or collective deconstruction of the task (e.g. scales). The individuality of musicians manifests in their learning process as much as in their performance. I now give what is in effect an analysis and description of my own experience as a user and teacher. (To reflect this, I am writing in the more informal first person rather than the more technical passive voice.) There is a large body of literature on the cognitive analysis of learning musical instruments[8, 10, 7], a survey of which would be beyond the scope of this paper. In contrast, here I focus on experientially-based approaches to long-term learning and observations.

4. BASIC ELEMENTS

The learning process tends to begin with my attempts at finding basic motions or exercises. I typically start with a task that is too hard, which I then break down to the most elemental pieces I can think of. With *Glove Talk II*, this meant breaking words into syllables and practicing individual phoneme production.

With *Digital Marionette*, where a long-term goal was the fluid animation of a complex 3D character, a basic goal was to achieve a bare-bones, functional bipedal locomotion in which knee and ankle motion was ignored, with intention of just getting the basic outline right (a kind of waddling). I then broke this into basic tasks including rotation of single joints by swinging body parts back and forth (a leg rotating around the hip, a shin swinging from the knee), and simply

[1]Demonstration videos showing the author playing the system are, at time of print, available at [1].

[2]An on-line demonstration video is available (at time of printing)[2].

shifting from one leg to another.

5. REFINEMENT

Once basic motions start becoming crudely realizable, there comes a point where I feel I can not only add new "basic" exercises, but also that I am beginning to refine something I can already do.

In *Glove Talk II*, the refinement included more accurate trajectories through the audible pitch and vowel spaces. It included more accurate coordination and timing of stop consonants within words, and better-sounding transitions between consonants and vowels. This involved more effective hand gestures, as well as better coordination of hand transitions as the arm was moving through vowel and pitch space.

In *Digital Marionette*, the refinement included making sure the legs were parallel as each one would swing through, which also meant better timing of the knee bend so that the swinging foot would not hit the ground. It included practising of the "falling forward" motion of walking. I spent time trying to control the speed of the centre of mass of the character (projected visually) to get steadier pacing. I experimented with more control over the some of the "filters" that processed the input signal, and tried to achieve softer knee action. Note that while these are not musical output events, they have the same kind of real-time control aspects as musical instruments on an instinctive level, from the point of view of someone learning to control this kind of output.

While the basic elements form the very initial part of the learning curve, the refinements extend it more, and it is somewhere during this phase that the much freer and truly exciting part just begins, driven by personal choices, learning style, goals, and the kind of general principles I now describe (which, in fact, also drove some of the choices when refining).

6. GENERAL CONCEPTS

These concepts are neither inherently "basic" nor "advanced". In this user's experience, they are helpful for moving beyond plateaus during the learning process. They are a way of generating new questions while practising, or remembering to re-ask old questions. While given from a personal perspective, I am drawing on experience from working with the instruments described above, but also based on studies of body-activities including Tai Chi with bona fide martial practitioners, competitive figure skating, West African and Cuban drumming and percussion, extended vocal techniques, and collaborations with dancers. Some of the concepts described are more concrete, in the sense that there are specific externally-supplied exercises that can help work on them. Others are more abstract, in that they are less quantifiably describable, yet refer to ways of approaching any of the other exercises.

6.1 Isolation

The basic elements described in Section 4– single joint motions for a virtual marionette, single phoneme production with a real-time speech controller, single notes for a classical instrument– are all examples of *isolation*-based exercises. The same concept appears in figure skating, where free-skaters and ice dancers are critically informed by the practise of "figures", in which the skater practices simply being on the "inside" and "outside" edges of the skate blade (by skating a curve on one foot leaning in and out of it), and switching between these edges. These edges are fundamental to all other figure skating moves.

In piano technique, isolation exercises are found in technical anthologies such as the collection by Isidor Philipp[11], where 4 fingers hold down keys while the free finger plays a repeated note, or while 3 fingers hold down keys in which case the 2 free fingers slowly alternate their respective notes. The great jazz pianist Lennie Tristano had an exercise playing scales with just the 4th and 5th finger alternating, in anticipation of improvisational settings so that one would not be "limited" by the finger they happened to be using if they wanted to go higher. The great virtuoso pianist, Vladimir Horowitz, had an isolation exercise playing 5-finger chords, while weighting the fingers differently, taking turns so each finger would be heard most loudly.

Isolation exerices are extremely valuable, almost universally across disciplines. Among other benefits, they provide the individual with a means of exploring, understanding, and hopefully internalizing the input-output relationship for a given instrument. They allow discovery of the basic elements of an instrument, provide the basis for combinatorial exploration (described below), and are inherently suited for practise in combination with other concepts, such as, for example, exaggeration and reduction.

6.2 Exaggeration/Reduction

Once an element has been isolated, an effective way of learning more about controlling it is by exaggerating it or reducing it as much as possible– whether in volume, or in physical motion when carrying it out, or in any other dimension. In *Glove Talk II*, once I was reasonably comfortable with the system, I was able to begin exploring the control of speech while making my own motions as minimal as possible. This also allowed (or would potentially lead to) increased ability for speed, as less motion would be required to produce the same words. In piano, exaggeration can take the form of raising the fingers as high as possible before striking the keys, or "pulling" them off the keys when releasing. In *Digital Marionette*, I explored swinging the leg as high as possible while walking, and also moving the legs as little as possible during walking, to gain more control over the leg motion overall. An interesting vocal exercise for dramatic or public speaking is practising improvised singing of an entire speech– this corresponds to great exaggeration of intonation and rhythm, so that when it is later spoken, there is still an underlying feeling of freedom with the phrasing, timing, intonation and volume.

6.3 Combinatorial exploration

Having identified isolated components, it is natural to then start explore various combinations of them. This also helps internalize the isolated gestures or elements, as they can be maintained under various situations, after having practised them in sufficient combinations.

Another combinatorial approach is epitomized by Slonimsky's thesaurus of musical patterns[12], in which he covers enormous territory in a remarkably systematic way[3].

6.4 Slow and Steady

[3]These patterns grew in popularity when it was became known that Coltrane would practise from this collection.

It is a trademark of novice players that they will practise the easy part of a passage too fast, and slow down unpredictably on the difficult parts. Yet, one of the most helpful and well-known practise techniques is working with a metronome. The key is truly understanding the simple idea of working at a common denominator so that the full passage or exercise can be practised completely steadily. Furthermore, the tempo can be chosen so that not only is it possibly to be unwaveringly steady, but also relaxed. With *Digital Marionette* and *Glove Talk II*, there were certain movement phrases or words that were easy to do much faster, but it was always helpful to practise things at a steady pace. Fundamentally, this is about developing sufficient internal awareness to recognize when a certain activity feels in control or not. This is very different from whether or not it sounds in control.

6.5 Rhythms

As an interesting representation of the difference between today's classical versus jazz understanding of time, a jazz metronome exercise is to set the metronome on a relatively slow speed, and then play a single note per beat, but try to nail it so that one doesn't even hear the tick of the metronome. Not surprisingly, an invaluable key to achieving this exercise is by staying relaxed. Even less surprisingly, it is very difficult to do that (see Section 6.8).

Listing even some of the possible rhythmic exercises (depending of course on the instrument) would be outside the scope of this paper. However, combinations of accenting and rhythms can be invaluable in learning to achieve steadiness. Practising short bursts of 2-4 notes followed by a slight pause allows one to learn to alternate between being active and relaxing. Practising the same rhythmic pattern starting at different places in the bar is a rhythmic form of isolation and combination, and can be extremely helpful in achieving comfort with the instrument.

6.6 Deeper interaction: finding limits and openings

As the knowledge of one's instrument deepens, it becomes interesting to look for both limits and openings for expressiveness. For example, the vowel mapping in *Glove Talk II* was an opening, in the sense that further exploration in this regard led to further control over the expressiveness of the instrument. On the other hand, the foot-ground contact mechanism in *Digital Marionette* was more of a limit, in that seemed to be something that needed to be overcome when trying to create fluid choreography. With an instrument such as the acoustic piano, the fact that a note cannot be directly controlled after it has been played is a limit, but the fact that sympathetic vibrations allow other notes to cause a held note to resonate more strongly is an opening for additional expressiveness, as that can help a pianist achieve a more "singing" tone.

6.7 Awareness

Body-awareness and mind-awareness are fundamental concepts to work with when learning a new instrument. A full discussion of them is philosophical and outside the scope of this paper, but a tangible, relevant example is awareness of posture. In classical technique, while specific ideas differ according to the school, one of the first elements taught to the beginning musician is (whatever that school believes to be) the "correct posture". While different postures have different proponents, each one invariably has some rationale behind it, with goals of satisfying certain criteria– whether to allow for more relaxation, or give more power, or give more physical range, or minimize required physical effort, etc. When confronted with a new instrument, it is very important to be aware of one's posture and give consideration to it in relation to what is needed in order to play it.

Another example of awareness is in the next concept.

6.8 Balancing relaxation with intention

This is one of the most elusive of the concepts to describe, yet it is perhaps one of the most fundamental ones when considering the meaning of mastery over an instrument. Great performers sometimes make their performance look easy. While what they are doing may be ostensibly difficult, what they have achieved— either over years of practise or by happening upon it very quickly— is that they have *found the ease* in it. It is in some ways useless advice, for saying it does not help find it, yet I believe it is hopeful to know that the easiness is there. A long search may happen first, but it is findable.

6.9 Revisiting

Returning to a basic or previous exercise can reveal what appears to be a brand new exercise, by being able to focus on new aspects of it or due to higher, revised standards. The performer may also be able to absorb the information of the exercise in a different way, or have a new kinesthetic perception of it. Recent research[10], showing the stronger transferability of skills in advanced users, supports the value of revisiting basic exercises.

6.10 DeAling wit Mistakes

By "mistake", I here refer to the occasions when the actual output was different from the intended output (assuming the performer had an intention in the first place). Mistakes necessarily happen during practise. It only makes sense to actually give thought to how one will treat them when they do present themselves. One approach, for example, is to decide— in advance— to keep going without missing a single beat (literally speaking). This is an extremely useful approach for improvisation. This was also a very important skill to learn with *Glove Talk II*, since, if a messed-up syllable was repeated, it became quickly incomprehensible to the listener who had no way of knowing that the same syllable was being "repeated-until-spoken-correctly", and was therefore trying to parse a sequence of sounds that would be impossible to interpret correctly without mentally deleting a certain section. The same happens musically when playing within a metric form. It is an important skill, and not an easy one to learn.

Another approach is to decide in advance to stop at every mistake, and repeat it until correct, or even more effectively, repeat until one has a feeling of physical confidence that that mistake will simply not happen. This can be extremely useful. Furthermore, this may be easier said than done, for it can require considerable focus to stay aware of mistakes when playing.

6.11 Play

I will not even try to describe how to be playful (best

done in demonstration), but, based on my experience, it would be inexcusable to omit mentioning it. It is amazing how much new territory can be discovered by playing (in any interpretation of the word).

7. CONCLUSION

Learning to play new musical interfaces is a very different task from designing them, yet no less important if they are to be used to full effect. While classical instruments come with an existing body of technique evolved over generations of master players and master teachers, the new-instrument performer must often be the initiator and driver of the exploration of the new instrument. The introductory stages are but a small part of it— the true creative journey begins when the user's own goals and style drive the learning, and when basic elements begin to be internalized and built upon.

Based on my experience becoming proficient at two complex real-time digitally-based controllers, and on years of study and performance of a conventional acoustic instrument, and numerous other coordinated movement and body-based activities, I present a set of general principles for guiding practising and learning a new instrument. While the principles are of course not meant to be perfectly suitable for every possible instrument (e.g. rhythmic exercises may be less relevant for an instrument that only produces very slowly-changing ambient-type soundscapes, or extremely relevant for a new percussive interface), and they do not purport to comprise all such principles, I believe they are sufficient to cover and inspire a significant range of directions and questions to consider when working. Each principle has been common in some way to my experience with one or more of the instruments or activities that I study or teach.

8. ACKNOWLEDGMENTS

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9. REFERENCES

[1] http://hct.ece.ubc.ca/research/glovetalk2/index.html.

[2] http://www.cs.smu.ca/~sageev/videos/digitalMarionette1.qt.

[3] T. Blaine and S. Fels. Contexts of collaborative musical experiences. In *Proceedings of the NIME 2003 Conference on New Interfaces for Musical Expression*, Montreal, Canada, 2003.

[4] S. Fels and G. Hinton. Glove-talkII: An adaptive gesture-to-formant interface. In *Proceedings of CHI'95 Human Factors in Computing Systems*, pages 456–463. ACM Press, 1995.

[5] S. Jorda. Digital instruments and players: Part I - efficiency and apprenticeship. In *Proceedings of New Interfaces for Musical Expression (NIME)*, Hamamatsu, Japan, 2005.

[6] T. Machover. Instruments, interactivity, and inevitability. In *Proceedings of the NIME International Conference*, 2002.

[7] R. K. Meyer and C. Palmer. Temporal and motor transfer in music performance. *Music Perception*, 21(1):81–104, 2003.

[8] A. Newell and P. Rosenbloom. Mechanisms of skill acquisition and the law of practice. pages 81–135.

[9] S. Oore, D. Terzopoulos, and G. Hinton. A Desktop Input Device and Interface for Interactive 3d Character Animation. In *Graphics Interface*, pages 133–140, 2002.

[10] C. Palmer and R. K. Meyer. Conceptual and motor learning in music performance. *Psychological Science*, 11(1), 2000.

[11] I. Philipp. *Complete school of technic for the pianoforte.*

[12] N. Slonimsky. *Thesaurus of Scales and Melodic Patterns.*

[13] R. Vertegaal, T. Ungvary, and M. Kieslinger. Towards a musician's cockpit: Transducers, feedback and musical function. In *Proceedings of the International Computer Music Conference*, pages 308–311, 1996.

[14] M. M. Wanderley and P. Depalle. Gestural control of sound synthesis. *Proceedings of the IEEE*, 92(4), April 2004.

[15] M. M. Wanderley and N. Orio. Evaluation of input devices for musical expression: Borrowing tools from hci. *Computer Music Journal*, 26(2):62–76, 2002.