Autonomous Virtuosity

> "Maybe he could turn the Practice Effect to his advantage, though he suspected it would work quite differently for a sophisticated instrument than for an ax or a sled. The very idea was too fresh and disconcerting for the scientist in him to dwell on yet."
>
> -- David Brin, *Practice Effect* (chap. The Best Way to Carnegie Hall)

Roger Reynolds once pointed out for me a hyper version of machine development: the "Practice Effect" imagined by sci-fi author David Brin in his fantasy world where tools get sharper through use, not duller [1]. I've never been able to shake this image of a world where the progress of evolution happens much faster and is guided by human need, while myself progressing at a much slower pace with my much less robust algorithms for automatic performance and composition. Perhaps music is one place where Brin's world is naturally the case. Deft use of an instrument (or voice) develops through practice. The hands and ears of a strong player acquire the ability to skillfully sculpt sound into musical patterns with uncanny temporal precision and acoustical shading, a growth which Frank Wilson, neurologist and hand specialist, says "illustrates the de facto evolution of intelligence taking place right under our noses." [2]

For the sake of exploration, I am going to pose a question about virtuosity ever becoming "virtual." This prospect could be an engineering feat of grand challenge proportions, or it could be a music-making fantasy of the kind that drives composers to experiment with algorithm design. Or it could ultimately be something that resides primarily in our ears, as I will explain.

Computer models in music increasingly supplant everything from acoustical instruments to sound engineers. Autonomous agents can play well-defined (but mechanical) parts in narrowly-defined musical styles or construct those parts. They can incorporate modules for analytic listening which monitor the musical environment and their contribution to it. Over time the sophistication of the agents' constituent algorithms inexorably grows. The agents recognized as the first virtuosi will exhibit traits and qualities with which artists are likewise recognized. Defined succinctly by Jed Perl, "Virtuosity is craft shaped by the imperatives of meaning." [3]

"Craft" in music equates with chops, that quality which builds with practice, whether performer, composer, luthier or sound engineer, and which makes the musician. Our presumptive virtuosi have their chops intact. Robotic vehicles, so beautifully exemplified by the NASA rovers, are also "crafty" in their own right, designed in engineering domains where robustness is the equivalent of musical chops. These craft are able to explore semi-autonomously in incredibly remote places. Their independence has evolved over decades as on-board decision making gains in sophistication. The supervisory aspects transmitted to rovers can move to higher and more abstract levels as algorithms running automatically in the system's "brain" become more robust.

Wilson is interested in the plasticity of the brain and that a musician's maturation is an expression of cultural progress.

> "This evolution does not represent a change in biologic intelligence, but the establishment of a culturally defined and valued form of intelligent behavior through early and intense educational manipulation and subsequent rewarding of musicianship, both with special incentives for success and severe penalties for failure. [...] Their musical development is subject to circumstances so unusual and extreme that professional musicians are actually evolving as *we watch*. It is a *virtual* new species, however, because the information controlling the new musical intelligence and skill is imbedded in musical institutions and has no effect on the genetic composition of living individuals." [2]

This is a two-way street, since the set of norms and institutions is plastic too, a result of so many individuals' gifts back to culture. Music produces virtuosi in continuous streams. The sequences of teachers and students who become teachers form braided, merging and diverging schools, worldwide. Master musicians cross tens of generations when charting for example, the gharana of sarod or tabla on the Indian subcontinent. Such histories emerge from deep time and are continuously evolving. Passed on from the teacher is both craft and a way of communicating meaning. Added by each individual is new meaning to be folded into the musical style. The folding-in is at the crux of virtuosity.

There are also rovers in Brin's story which arrive ahead of humans and scout his world in much the same way as NASA now has a presence on Mars. The Practice Effect works its improvements and we get a glimpse of sharpened agents whose algorithmic abilities transcend "robustness." The initial point-of-view of the story's human protagonist clouds his appreciation of the phenomenon such that his partner scout seems to be going about its normal business. As events unfold, he learns that his limited expectation kept him from seeing the robot's enhanced capabilities. He discovers that it possesses extremely advanced decision making and an ability to communicate useful (meaningful) insights about the strange planet they are both destined to explore.

POV also constrains music listeners and by extension the ability of musical "institutions" to fold-in newness. If autonomous agents developed virtuosity, we wouldn't know it unless our POV permits us to. In other words, as a robust chops-rich agent-performer acquires "imperatives of meaning," unless we are in a receptive state that communication will be ignored. Kind of like saying that we can't play our role in a Turing test unless we're listening to start with.

Adapting our POV so that we can hear liberally *should* be easier than answering the next question, which concerns the nature of the added substance and how it gets there. For players, there exist essences which drive their best playing. Some call it spirit, others zones of being, or resonances. No engineering spec to be found there, and our agent factory is going to be on standby for a long time before it completes a purchase order for quantities of spiritual essence. One hint about this added "input" comes from the body.

The musical "brain" is a larger concept, encompassing somatic extensions to the limbs and even the musical instruments themselves. Exogenous improvements have shaped the histories of musical meaning. Virtuosic instruments ("gesture amplifiers") have evolved along with the skill of their performers. Wilson asks, "What might happen if the body no longer were to define, limit, or even help `calibrate' the brain's continuing experiment to expand its reach?" Breaking free of the body is not without reference to it. We could ask computer-mediated instruments to afford the same possibilities, that designs for human / computer interfaces both couple with and transcend the body's constraints. Designs in musical synthesis along physical lines have already shown a dual nature of being grounded in known territory but free to escape. Virtuosic agents would be "practiced" by exercise in a world of synthetic "praxis" while their authors are listening and waiting for those moments of flight. Autonomous designs will simply be detachable.

"What couldn't a man who knew what he was doing accomplish, simply by using the Practice Effect on a sophisticated little machine like that?"

-- (chap. Ballon d'Essai)

[1] Brin, David, *Practice Effect,* Bantam Books, NY, 1984.
[2] Wilson, Frank, *The Hand,* Pantheon Books, NY, 1998.
[3] *The New Republic*, Jed Perl on Art, "Oh, Cool" Sep., 2003.

Chris Chafe, for Roger Reynolds' 70th Birthday
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