Creativity through Style Manipulation: the Flow Machines project

François Pachet, Pierre Roy and Fiammetta Ghedini

Sony Computer Science Laboratories – Paris, 6, rue Amyot, 75005 Paris

Presenter email address: pachetcsl@gmail.com

Summary

Flow Machines intend to boost individual creativitity for sequential content creation such as music composition and litterary text writing. This paper introduces the main concepts underlying the Flow Machines project. Starting from Csikszentmihalyi's Flow theory, we posit that the main driving force of individual creativity is not to acquire more skills nor to create individual artefacts, but lies in the creation of individual styles, and that creative artefacts are merely instances of novel styles. Flow machines intend to assist users in style creation by allowing them to explicitly manipulate styles as computational objects. Such an endeavour raises complex technical issues related to the exploration of statistical models of styles under arbitrary constraints. We illustrate these ideas through examples in music composition and text writing.

I. CREATIVITY AS STYLE MAKING

A. Singular creations versus styles

Even if creators are usually known by one of their key production, creative artefacts are rarely unique, and usually come in series. Einstein is known for special relativity, but his genius and creativity was applied to many other domains (general relativity, photo-electric effect, etc.). Picasso's famous bull (Cf. Figure 1) is only one example of a large series of drawings involving only simple lines. The song Yesterday by the Beatles is a popular hit by McCartney, but he composed many other songs of this kind and quality (Eleonor Rigby, She's leaving home). We argue that the core outputs of creative behavior lies in the creation of unique *series* rather than unique works of arts. What all these series have in common is commonly called *style*.

B. Style and situations

Another inspiring feature of style development is that it often consists in *applying* existing styles to new *situations* or contexts. For instance, it can be argued that the Beatles own part of their success (especially for the later years) to their unique way of introducing the harmonies of classical music in the pop genre. Similarly, Picasso's cubism can be seen as the application of a rather mechanical drawing scheme hitherto never applied to classical painting subjects such as characters or animals.

Creators achieve such combinations by evolving from previous styles. Figure 1 shows several variations of bull drawings by Picasso, from classical to stylised ones. However, it is largely accepted that style invention, and creation in

general, requires long hours (the "10,000 hour rule", Gladwell, 2008) of playful manipulations and experimentations with techniques and styles of predecessors.
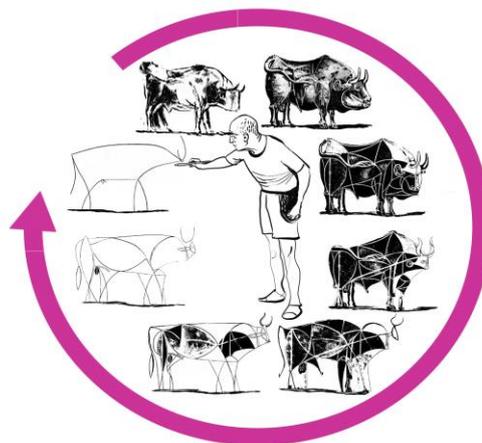

Figure 1. Picasso's bulls illustrate style evolution.

C. From skills to style

In the context of the Flow theory (Csikszentmihalyi, 1975), style creation can be seen as a natural prolongation of skills acquisition. When all required skills are acquired (which is often the case for creators), the next natural step is to create their own, unique style (Figure 2).
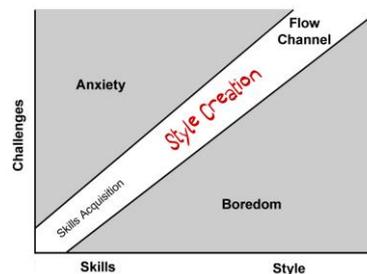

Figure 2. The flow diagram continued: skills become style.

II. FLOW MACHINES

Flow machines are interactive computer programs that let users literally *play* with styles. We focus here on sequential content, i.e. content that can be faithfully represented as sequences of items, such as text or music. In this context, we equate *styles* with *corpora*: the style of a composer is defined by the corpus of sequences he/she has composed, or a subset deemed

representative. Of course, there is more to style that corpora, but we consider that the core problem lies not in the definition of style, but in the way styles can be playfully *manipulated* and tweaked to explore new ideas. How?

A. *The core technical problem*

In (Pachet & Roy, 2011) we identified the core technical issue that arises when one attempts to generate finite-length sequences from Markov models that satisfy arbitrary constraints, representing situations that a user wants to explore. We introduced *Markov Constraints*, a promising class of algorithms to address and solve the problem. We showed in particular how jazz virtuosity may be modeled as a Markov sequence generation problem with unary constraints holding on specific notes of the melody (Pachet, 2012).

B. *Music Composition*

Some interesting sequences have already been exhibited for music composition using such a scheme. For instance, the so-called "Boulez Blues", is the result of applying the style of Charlie Parker Blues compositions (we consider here only harmony, i.e. sequences of chords), with a "Boulez" constraint that all chords be different. We exhibited the most probable of them, i.e. a chord sequence that sounds optimally like Charlie Parker, while satisfying the constraint: a strange object indeed, that lies on the fringe of bebop chord sequences. Current works involve the development of a "Flow Jazz Lead Sheet Composer", with which users can generate melodies and harmonies by selecting their favorite composers (e.g. Coltrane, Miles Davis, Wayne Shorter, etc.) from a comprehensive database of jazz standards (Pachet et al., 2013). Specific tools allow them to *paint* a targeted sequence by applying the style to various segments of the sequence: a beginning "like" Miles Davis", than a segment" more like Wayne Shorter", and possible adding specific properties, such as "One occurrence of a F# 7 in this sequence", etc.

C. *Poetry*

Flow Machines are applied to text in the same manner. Through a collaboration with Mirko Degli Esposti (department of Mathematics of the University of Bologna), we have shown that Markov Constraint techniques can be used to generate text sequences that were hitherto unreachable with conventional techniques. In (Barbieri et al., 2012) we rewrite the lyrics of songs such as Yesterday by the Beatles in the style of any author for which we have a sufficiently large corpus. We can keep the "properties" of the original song, such as its *prosody*, *rhymes* and *syntax*, and apply the style of, say, Bob Dylan, the Beach Boys or ACDC to these constraints. The resulting texts satisfy the constraints, while being "in the style of" the selected author. The prototype is now being augmented with more complex constraints such as meter (Roy & Pachet, 2013). This will enable users to generate, for instance, alexandrines in the style of Marcel Proust or Churchill. More prosaically, we envision email assistants able to generate phrases or paragraphs in the style of the user, while being controlled by high-level targets such as structural properties or semantics (a phrase that talks about a particular subject).

III. THE BIG QUESTIONS

The FlowMachine project (which received funding from an ERC Advanced Grant, agreement n. 291156) raises many conceptual and technical issues concerning the *reification* of style, i.e. its representation as a computational object. A key mathematical question concerns the relation between style and probabilities. A sequence that has a high probability in a given statistical model is not necessarily stylistically recognizable for humans, because it may use many commonly used words: notions of *typicality* should ideally be incorporated to control generation more intuitively. Other questions concern the mathematics of style exploration. Generating sequences from a statistical model that satisfy arbitrary constraints raise complex combinatorial problems. Some of them have been solved (unary constraints, cardinality or meter). Others are probably out of reach for interactive systems (i.e. polynomial complexity is probably impossible). For instance, "nice melody" generation should involve not only Markovian properties but also specific distributions, such as 1/F (Voss & Clarke, 1975). This problem is currently being addressed using so-called global constraint techniques (Beldiceanu et al., 2007).

Regardless of these questions, we believe that explicit style manipulation is a key mechanism in style creation. This project should generate novel ideas and data that we hope will benefit to creativity studies in general.

REFERENCES

Barbieri, G., Pachet, F., Roy, P. Degli Esposti, M. (2012) Markov Constraints for Generating Lyrics with Style. In Luc De Raedt et al., ed., ECAI, pp. 115-120.

Beldiceanu, N., Carlsson, M., & Demassey, S. (2007). Global constraint catalogue: Past, present and future. Constraints, 12(1), 32–62.

Csikszentmihalyi, M. (1975) Beyond Boredom and Anxiety: Experiencing Flow in Work and Play, San Francisco: Jossey-Bass.

FlowMachines (2012) The Flow Machines project web site: http://www.flow-machines.com

Gladwell, M. (2008). Outliers, the Story of Success, Allen Lane.

Pachet, F. and Roy, P. (2011) Markov constraints: steerable generation of Markov sequences, Constraints, 16(2):148-172

Pachet, F., Roy, P. and Barbieri, G. (2011) Finite-Length Markov Processes with Constraints, IJCAI, pp. 635-642, Barcelona, Spain.

Pachet, F. (2012) Musical Virtuosity and Creativity. In McCormack, J and d'Inverno, M, editor, Computers and Creativity, Springer.

Pachet, F., Suzda, J., Martin, D. (2013) A Comprehensive Online Database of Machine-Readable Lead Sheets for Jazz Standards. ISMIR, Curitiba (Brazil).

Roy, P. and Pachet, F. (2013) Enforcing meter in finite-length Markov sequences, in AAAI 2013, Bellevue, WA, USA.

Voss, R.F. & Clarke, J. (1975) '1/f noise' in music and speech, Nature, 258, 317–31.