Designing for Style in New Musical Interactions

Michael Gurevich, Paul Stapleton, Peter Bennett
Sonic Arts Research Centre
Queen's University Belfast
BT7 1NN
UK
{m.gurevich, p.stapleton,pbennett02}@qub.ac.uk

Abstract

In this paper we discuss the concept of style, focusing in particular on methods of designing new instruments that facilitate the cultivation and recognition of style. We distinguish between style and structure of an interaction and discuss the significance of this formulation within the context of NIME. Two workshops that were conducted to explore style in interaction design are described, from which we identify elements of style that can inform and influence the design process. From these, we suggest steps toward designing for style in new musical interactions.

Keywords: expression, style, structure, skill, virtuosity

1. Introduction

Bill Verplank has defined style using the following example: Given a task of drawing a line from A to B, style accounts for the individual variation with which a particular person draws that line. [1] According to this definition, style is a function of both the user and the tool with which they perform the task. With a red paintbrush, one can make thick, textured, red strokes; with a black ballpoint pen and a ruler one could make a thin, precise, straight, black lines. In using this definition, we claim that designers can influence style in new musical interactions.

Brand and Hertzman [1] created a machine learning system for "stylistic motion synthesis" capable of generating or transforming a set of recorded human motions to reflect a certain style, in addition to interpolating and extrapolating from the set of learned styles. They differentiate between *structure* and *style* using a state space approach, along the lines of Verplank: "We take the *structure* of bipedal locomotion to be a small set of dynamically significant qualitative states along with the rules that govern changes of state. We take *style* to be variations in the mapping from qualitative states to quantitative observations. For example, shifting one's weight load onto the right leg is a dynamically-significant state common to all forms of bipedal locomotion, but it will look quite different in running, trudging, etc."

It is important to note that structure is not necessarily a set of physical actions, as in the example of bipedal locomotion [1], but may also be defined as an abstract but realizable concept. For example, the structure of a task may be to play a C major chord; the styles of different realizations may be reflected in timing, register, voicing, dynamics and choice of instrument.

1.1. Scalability of Structure

Structure may be considered on different scales, relating to the size of the set of states and transition rules in Brand and Hertzman's formulation. As the structure becomes increasingly specific, the set of states and transitions becomes larger and the possibility for stylistic variation decreases. Structures such as "playing music","playing a piano", "playing the keyboard of a piano", "playing a C major triad on a piano with the right hand" are increasingly constrained, and thus reduce the variations in style with which they can be realized. This is not to say that larger, more specific structures are a bad thing; in §4.2 we discuss the potential importance of constraint in facilitating the recognition of style.

1.2. Structure and Style in the Context of NIME

Our conception of style follows those of Verplank, Brand and Hertzman, but accounts for the fact that in NIME, the structure is not always as easily defined as drawing a line from A to B, nor is it necessarily specified *a priori* (in a score or performance instruction, for example) [2]. Thus, unlike *expression*, which implies extra-musical content that is added to pre-existing text [3, 4, 5, 6, 7, 8], this formulation of *style/structure* accounts for non-expressive, improvisatory and experimental practices as the first author advocated in [9], while maintaining a perspective of communication within the performance ecology.

1.3. Personal Style

That style arises as a product of both a performer and the system with which they interact leads to the notion of personal style, which we can define as a pattern of stylistic

[1] Unpublished personal communication

variations that may be uniquely attributable to a particular performer-system interaction. Personal style may arise both a result of intention (John Coltrane chose to play lots of notes, Miles Davis didn't) or inherent physical or cognitive constraints in the interaction (Def Leppard's Rick Allen's personal style of drumming is greatly influenced by his lack of a left arm). Personal style may or may not translate from one interaction to the next, due to the presence or absence of common constraints (Rick Allen's singing is likely less personally identifiable with respect to his drumming than John Coltrane's tenor sax playing with respect to his soprano sax playing), along with the situational nature of the realization of these interactions (Picasso's early modernist paintings may not appear to be the work of the same artist as his analytic cubist works just a few years later).

Drawing from a discipline outside of the arts, the basketball slam dunk competition provides an example of a situation where personal style can be clearly identified. Unlike many musical interactions in the context of NIME, the slam dunk competition offers an unambiguous separation between structure and style. The structure is simply to slam dunk the basketball into the hoop. Players are then judged on the complexity and innovation added, in the form of their personal style, to the successful realization of this structure. Although these subjective value judgments on style are demanded by the context of a competition, this event strongly resembles many other forms of performance in that it is primarily a spectacle of skill and creativity.

1.4. What We *Don't* Mean by Style

Style is a potentially problematic term because it has a variety of meanings in different contexts. We differentiate between *material style* and *interaction style*, where the former refers to the design of physical properties or decoration of an object, such as colour, shape and texture. Material style is found in the cut and fabric of a shirt. Our concern is rather interaction style, which similarly represents variation on a structure, but instead focuses on variations in the process of realizing an instance of that structure. We are therefore more interested in styles of interacting with the tools used to make a shirt, rather than the material styles of shirts themselves.

We also distinguish between *style* and *idiom* or genre [2], which we take to be a set of established conventions that contribute to an increasingly specific structure. Although one could say that Twisted Sister's glam metal anthem "We're Not Gonna Take It" can also be performed in a ska idiom [3], we consider the constraints imposed by this genre to contribute to the structure of this particular performance rather than its style.

[2] The relationship between different concepts of style and genre is also a subject of discussion in musicology that is beyond the scope of this paper. Instead we focus on our definition of style arising from interaction design that is developed above.

[3] As in Whole Lotta Milka's "Twisted"

2. Style, Expression, Skill and Virtuosity

Expression is given as an explicit goal in NIME, but an examination of the literature suggests that many are actually talking about what we call style, rather than expression [4, 10, 11, 12, 13, 14]. We therefore propose shifting the NIME discourse from expression toward one of style and structure. This acknowledges that each interaction between a performer and digital music instrument gives rise to a unique performance, but liberates us from the concerns of emotional content and its successful delivery to a spectator.

We differentiate between style on the part of a performer and a spectator's ability to *recognize* style, which for a given performance requires them to formulate a distinction between its structure and style. That is, the very existence of style does not guarantee that it is effectively communicated to a spectator.

For many, assessing style is no doubt an important factor when forming aesthetic judgments. In order for spectators to recognize style, they must be able to formulate this structure/style separation, which necessitates their ability to form a mental model of the interaction [15]. As we describe in another paper [16] the spectator relies on this mental model to assess error or success. Success (a continuous judgment that can be considered the inverse of error), together with an assessment of the degree of difficulty, forms the basis for judgment of skill. From this perspective, in order for a performance to be deemed skillful it must reflect both some degree of success and difficulty.

The literature also demonstrates a desire for virtuosic performances with new digital instruments [17, 18]. We propose that style is an important component of virtuosity, along with a high degree of skill. A virtuosic performer does not only successfully realize a highly demanding task, but does so with stylistic variations on its structure. The demand for virtuosity therefore creates a challenge to design interactions that foster style as well as skill.

3. Workshops on Stylistic Interaction Design

Two workshops titled "Designing Stylistic Interactions" were held with the aim of developing a model of style. We sought to identify elements that contribute to both the recognition and cultivation of style, and from these to abstract lessons, principles or tactics that could inform the design of new musical interactions.

The first day-long workshop took place as part of the TWEAK festival of interactive art and electronic music in Limerick City, Ireland. The workshop was structured around two large-scale tasks. The first involved going out into the world and documenting an interaction that already had some element of style. The participants prepared posters presenting their documentation of the observed interactions incorporating sketches, photographs, re-enactments and text. Participants were encouraged to find an interaction that was

repetitive and did not require a significant amount of conscious thought on the part of the user. In addition, they were steered toward interactions where they could observe more than one person attempting to do the same thing.

The second task was to redesign the interactions that were observed previously in order to encourage the development of style by the user. This was introduced with a short presentation on physical sketching, along with the difference between sketching and prototyping, illustrated by the development of the BeatBearing instrument [19]. Participants then used simple materials (e.g. paper, pipe cleaners, modeling clay, foam core, tape, pins) to physically sketch possible ways of redesigning their chosen interaction.

The second workshop was given over two days as the first of this year's *Adventures in Interdisciplinarity* that make up a part of Queen's University Belfast's Interdisciplinary Arts MA program. An additional requirement imposed by the context of the course was that the "Adventure" must lead to a public presentation in the evening of the second day. As a result, we implemented a second redesign task where the participants were required to create a "living" physical sketch of their improved interaction.

The living sketch was required to be human-scale but free of digital technology; the participants had to devise ways of demonstrating the functionality and stylistic variations of their design to an audience using only their bodies and the sketching materials that were available. All participating groups based their redesign on the same observed interaction in order to compare the effectiveness of different elements of design in facilitating style. The given interaction was a means for a pedestrian to stop traffic and safely cross the street, a redesign of the highly problematic but ubiquitous existing system involving a button, a traffic light and a walk/don't walk sign.

4. Discussion

We discuss two different aspects of the outcomes of the workshops. First, we highlight issues that arose as a result of our methodology. Then, using reflection and critical analysis, we refine our initial suppositions regarding style and present some challenges and tactics for designing for style.

4.1. Methodological Implications

Although some of the language we used during the workshops may have clouded this important distinction, upon reflection we are not concerned with quantitative comparisons of style (i.e. an interface that affords "more" or "less" style). Rather, we are looking to design interactions that facilitate both stylistic diversity (a high degree of variation in different realizations of the same structure), and the ability for a spectator to recognize this diversity as stylistic variation on a structure.

The emphasis on designing for stylistic diversity relates strongly to Resnick's [20] focus on "wide walls". Where, for a given design, conventional thinking considered the floor–the ease with which a user can produce a reasonably successful result–and the ceiling–the degree to which skill can be developed–Resnick proposed examining also the walls–the range of possible interactions.

Physical sketching aided the discussion of style in that it allowed sketches to be used as props in order to demonstrate or simulate stylistic variations. The "living sketch" exercise of the second workshop took this a step further by addressing the recognition of style by spectators. Although the participants identified (implicitly or explicitly) some of the design lessons we highlight below, particular styles were difficult to predict until the interaction was simulated. In the living sketch exercise, one design featured a large piano keyboard embedded in the pavement that pedestrians could activate while crossing the street. It was only when they began acting out scenarios that this group realized the possibility for interactions between two pedestrians crossing the street simultaneously in both directions.

Participants at times could not resist the urge to redesign the interactions to be more efficient or effective, not necessarily stylish. In our first workshop, one group observed ATMs. In the subsequent redesign, the group ended up addressing functional improvements in response to problems they had found, rather than considering style. It was notable that in addressing these problems, the designs they produced were remarkably similar, not only to each other, but also to existing ATMs. These groups did not sufficiently abstract the structure of the interaction, which could have been something as simple as "securely getting cash from your bank account at any time of day". Upon further discussion, identifying this structure led to a variety of radical redesigns that appeared to facilitate a much greater diversity of styles. This suggested that considering interactions in terms of their style and structure could lead to design innovations that diverge from existing realizations.

4.2. Design Implications

Designing for style in NIME presents a significant challenge. In other domains, structural constraints imposed by established traditions, including idiom and performance practice, can facilitate the communication of structure and style. But as a largely experimental practice consisting of entirely novel interactions, NIME tends to forgo traditions.

Lacking an established performance practice or community of users, unique instruments must somehow communicate structure and style in the interaction. We don't prescribe a single way of accomplishing this, but we offer the example of Henry Cowell's *Rhythmicana*. Alternatively titled *Concerto for Rhythmicon and Orchestra*, the piece features the Rhythmicon, an electronic instrument invented by Cowell and Leon Theremin in the 1930s [21, 22, 23]. The Rhythmicon had a keyboard with 17 keys. Each successive key played a steady pulse at a frequency and tempo that

was an increasing integer multiple of the first. Although the piece has never been performed using the actual instrument [21], had it been premiered as scheduled in 1932 it would have been witnessed by an audience that had very little concept of electronic instruments and virtually no idea how the Rhythmicon worked. The first movement of *Rhythmicana* is clearly designed to demonstrate the Rhythmicon's capabilities. It begins without orchestra, the solo performer playing first the lowest key for four measures, then adding the second, the third, and so on, at regular intervals until the entire range of the instrument has been demonstrated, after which different keys are played in combination before the orchestra enters. This has the clear effect of providing a sense of structure to the audience, upon which they can subsequently assess the style with which the instrument is played.

The concept of *risk* was identified as a valuable element in facilitating style. An interaction can be structured to allow for stylistic variations that increase the risk of failure, which was observed to be an effective means of communicating style. During the TWEAK workshop, one group observed employees of a smoothie shop using blenders. One proposed redesign was a larger machine resembling a woodchipper with a hole into which the employees could toss fruit, ice or other ingredients. In sketching the interaction, it was noted that although the structure requires little skill to perform successfully, it could lead to a variety of interactions that elaborated upon its complexity. Much like the aforementioned slam dunk competition, users could toss the fruit from behind their back, from a great distance or through their legs. This increased risk of failure had a profound impact on style. It was noted that another element of risk, the inevitable image of a user's hand caught in the teeth of the machine, also made the interaction appear to afford a greater diversity of style.

We propose the existence of a "sweet spot" between an overly loose or constrained structure in an interaction in order to facilitate style and its recognition. The sweet spot is admittedly more of an area than a point, and is highly variable depending on a variety of conditions particular to a given interaction. Nonetheless, we assert that both excessively structured interactions and overly free ones can be detrimental to style. A highly constrained structure can impede stylistic diversity because it can suggest or allow an excessively limited range of realizations: There are a very limited number of techniques that will allow one to juggle ten balls, but juggling three balls offers a large number of stylistic possibilities [24].

Lack of constraints on structure can arguably afford a greater diversity of styles, but they may be more difficult to recognize: The structure of *juggling*–tossing multiple objects from hand to hand–facilitates the differentiation of juggling tricks (e.g. shower vs. cascade) as stylistic variations on a common structure much more readily than a significantly looser structure such as *things I can do with 3 balls* (e.g. holding them in one hand vs. placing them on the table). While these latter interactions could technically be considered variations on this much looser structure, a spectator would find it nearly impossible to discern the structure, and therefore the style, from these two observations.

The example of juggling also leads to the observation that embodied knowledge of a physical system may aid spectators in identifying structure. This can be considered as a translation of Dourish's [25] theory of embodied interaction to the perspective of a spectator. Juggling relies on the spectator's embodied knowledge that dropping something is inherently wrong. The relative rigidity of the structure, degree of observed effort and our ability to comprehend observed actions in terms of our own [26], contribute to embodied assessments of success, difficulty, skill and style.

A design tactic arising from this concept of a style sweet spot is to consider adjusting the scale of the structure as a part of the design process. Prototypes or sketches that vary the number of parameters, features, degrees of freedom, allowable actions or handles and buttons can help designers locate structures where there is enough freedom for style to emerge, but not too much that structure is not discernible. A notable recent example [27] implemented this tactic in seeking to create infrainstruments, devices with "restricted interactive potential" by stripping away features of existing instruments. Although the results may have been toward the extreme of limiting the cultivation of style, the approach is nonetheless quite revealing.

Even for a given physical interface, imposing structure by varying other constraints of the interaction (through programming, for example) can radically affect the facility to develop style. The BeatBearing instrument [19] allows the user to create a rhythmic pattern by placing ball bearings on a grid. In multiple performances that move toward creating the same beat, random access to the grid allows for variation in style through the choice of timing and sequence of steps. A different programming of the interface that only allowed a linear progression of states (e.g. kick drum first, then snare, then cowbell) would impose rigid constraints on the structure that may impede the development of style.

Style and functionality are not mutually exclusive; in fact, considering style sometimes suggested functional improvements. In our living sketch exercise, one group used the metaphor of a "touch lamp", where the entire surface of a structure at the intersection would activate a familiar traffic control system involving sonic (beeping) and visual (walk / don't walk) feedback. While maintaining a one-button interface, simply changing the scale of that button from finger-sized to body-sized led to a greater diversity of styles but also a variety of potential functional improvements: the ability to activate the system with your hands full, improved hygiene and increased accessibility. Of course, the actual functional benefits of these would ultimately have to be empirically tested in light of potential trade-offs, but it is sig-

nificant that these arose through the consideration of style.

The relationship between style and functionality led to further observations about the interplay between design and redesign. As in the ATM example above, the previous traffic control example demonstrates that the consideration of style should not necessarily be relegated to a later stage of a linear design process after needfinding, problem solving and formgiving. The consideration of style can be conceived as a creative method; a mental leap ahead that may propagate backward to suggest new problems or functional solutions.

The workshops to date have played a significant role in the process of our research into the cultivation and recognition of style in performance. We aim to refine future iterations of the workshop with the goals of developing a rigorous language and set of principles for designers of new musical interactions.

5. Acknowledgments

The authors would like to thank all of the participants in our workshops, as well as those who facilitated their organization: Anna Newell and Juliana Licinic from CETL at Queen's University Belfast, and Nora O'Murchú from the University of Limerick.

References

[1] M. Brand and A. Hertzmann, "Style machines," in *Proc. of the Conf. on Computer Graphics and Interactive Techniques*, 2000, pp. 183–192.

[2] U. Eco, "The poetics of the open work," in *Audio Culture: Readings in Modern Music*, C. Cox and D. Warner, Eds. Continuum Press, 2004, pp. 167–175.

[3] S. Davies, "Philosophical perspectives on music's expressiveness," in *Music and Emotion*, P. Juslin and J. Sloboda, Eds. Oxford University Press, 2001.

[4] C. Poepel, "On interface expressivity: a player-based study," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2005, pp. 228–231.

[5] ——, "Formalized and non-formalized expression in musical interfaces," in *Transdisciplinary Digital Art. Sound, Vision and the New Screen*, R. Adams, S. Gibson, and S. M. Arisona, Eds. Springer, 2008, pp. 358–373.

[6] P. N. Juslin, "Emotional communication in music performance: A functionalist perspective and some data," *Music Perception*, vol. 14, pp. 383–418, 1997.

[7] R. K. Scherer and M. R. Zentner, "Emotional effects of music: production rules," in *Music and Emotion*, P. Juslin and J. Sloboda, Eds. Oxford University Press, 2001.

[8] R. Taruskin, *Text and Act: Essays on Music and Performance*. Oxford University Press, USA, 1995.

[9] M. Gurevich and J. Trevino, "Expression and its discontents: toward an ecology of musical creation," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2007, pp. 106–111.

[10] A. Camurri, C. Canepa, and G. Volpe, "Active listening to a virtual orchestra through an expressive gestural interface: the orchestra explorer," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2007, pp. 56–61.

[11] A. Knörig, B. Müller, and R. Wettach, "Articulated paint: musical expression for non-musicians," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2007, pp. 384–385.

[12] T. M. Lippit, "Turntable music in the digital era: designing alternative tools for new turntable expression," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2006, pp. 71–74.

[13] E. Chew, A. François, J. Liu, and A. Yang, "ESP: a driving interface for expression synthesis," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2005, pp. 224–227.

[14] E. Franco, N. Griffith, and M. Fernström, "Issues for designing a flexible expressive audiovisual system for real-time performance & composition," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2004, pp. 165–168.

[15] J. K. Doyle and D. N. Ford, "Mental models concepts for system dynamics research," *Syst. Dynam. Rev.*, vol. 14, no. 1, pp. 3–29, 1998.

[16] A. C. Fyans, M. Gurevich, and P. Stapleton, "Where did it all go wrong? A model of error from the spectators perspective," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2009.

[17] C. Dobrian and D. Koppelman, "The 'E' in NIME: musical expression with new computer interfaces," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2006, pp. 277–282.

[18] D. Wessel and M. Wright, "Problems and prospects for intimate musical control of computers," *Compututer Music Journal*, vol. 26, no. 3, pp. 11–22, 2002.

[19] P. Bennett and S. O'Modhrain, "The BeatBearing: a tangible rhythm sequencer," in *Proc. of NordiCHI 2008: 5th Nordic Conference on Computer-Human Interaction (electronic proceedings)*, 2008.

[20] M. Resnick and B. Silverman, "Some reflections on designing construction kits for kids," in *Proc. of the Conf. on Interaction Design and Children*, 2005, pp. 117–122.

[21] M. Schedel, "Anticipating interactivity: Henry Cowell and the Rhythmicon," *Organised Sound*, vol. 7, no. 03, pp. 247–254, 2003.

[22] N. Didkovsky, "Recent compositions and performance instrument realized in the Java Music Specification Language," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2004.

[23] L. Smith, "Henry Cowell's Rhythmicana," *Anuario Interamericano de Investigacion Musical*, vol. 9, 1973.

[24] M. Truzzi, "On keeping things up in the air," *Natural History*, vol. 88, no. 10, pp. 44–54, 1979.

[25] P. Dourish, *Where the Action Is: The Foundations of Embodied Interaction*. MIT Press, 2001.

[26] S. Blakemore and J. Decety, "From the perception of action to the understanding of intention," *Nature Reviews Neuroscience*, vol. 2, no. 8, pp. 561–567, 2001.

[27] J. Bowers and P. Archer, "Not hyper, not meta, not cyber but infra-instruments," in *Proc. of the Conf. on New Instruments for Musical Expression (NIME)*, 2005, pp. 5–10.