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Gesture–Ink–Sound: Linking Calligraphy Performance with Sound

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Abstract

In calligraphy, a brush stroke is rooted in an inner image, breath and the uninterrupted flow of movement. The same can be said of a bow stroke on a string instrument or a note sounded on a wind instrument. This article documents the encounter between a specific, two-person form of calligraphic performance, movement analysis techniques, and the mapping of brush gestures to sound processes. It shows how, based on data obtained in motion-capture sessions, the link between gesture and sound is established. This enables different models of sound processes, their specific mode of operation, and the understanding of what makes a stroke. Questions and issues arising from this concrete work are collected and a reflective analysis is carried out via a diagrammatic process. A discussion of critical limitations and possible extensions in this configuration concludes the article.

Keywords:

Gesture, Calligraphy and Sound, Motion Capture, Mapping, Movement Analysis, Domain Translation

Brush-Tip

What if a brush stroke contained more than the out/line to be transferred from the body to the canvas? The full process of painting or drawing involves perception, intention, skill, actions, and materials. When carried out with brush and ink on paper (or silk), this full cycle from imagination to ‘image’ (Bergson, 1911, p. 11), from intention to action, from heart to hand to eye involves all the capabilities of the human body-mind (Varela et al., 1991).

Intentions and imagination are captured in the skillful applications of strokes, in which the original gesture of the painter is still visible as the dynamics of the trace of the *brush-tip* on paper.

The connection to music may not be obvious at this point. Why would the stroke of a brush with ink on paper be relevant for thinking about sound and music? What do the time-based and ephemeral sounds have in common with the materiality and tangibility that are inscribed with ink on silk?

Even on a superficial level, it would appear that a link between calligraphic and musical performance exists: in both cases actions and materials are articulated as ‘gestures’ in order to convey an expression of intentions and perhaps even emotion. Both the calligrapher’s and the musician’s actions are bodily expressions through gestures, that are carried out with a specific goal. They are channeled through the specific materials, practices, and traditions of each discipline and culture. Their expressive qualities originate and have their effectiveness in the same perceptual, affective, and communicative capabilities given by the body.

In musical practices, the actions, gestures, and playing techniques on conventional instruments form the basis of the musician’s skills. The same is the case for the calligrapher: A brush stroke produces a single element of a drawing or painting, much as a bow stroke on a traditional instrument produces a single tone or note. Intention guides movement, its dynamics and intensity; the performer’s skill lies in linking it with the executed movement and the resulting sound or ink-stroke.

Framing this Article

At this point it is important to state that the present writing does not attempt to assert a specific phenomenon. This would go far beyond the scope and the capability of the current con/text.

The aim is rather – by laying out the basic elements and practices, by carrying out concrete exploratory work on a performance with technical methods, and by then, in a synthetic move-

ment, juxtaposing these elements in an in-depth reflection – to demonstrate that practice-based investigations, not beholden to the rigid and limited criteria of deductive proof of sciences, can generate novel and valid insights and understanding of a different kind.

The reflection that attempts to tease out possible connections and insights does not need to be inductive or deductive, but can function to establishing meaning by showing how elements are entangled in a dynamic process (Barad, 2007; Ingold, 2008). This knowledge is important for specific arts-related contexts, even if traditional disciplines such as computer sciences and engineering, cognitive- and neuro-sciences, and even HCI and design research impose a different paradigm. Above all, it fills a gap that prevents us from moving forward (Feyerabend, 1970; Kuhn, 2012; Stengers, 2010).

Open Scroll

In Chinese tradition, the art of Calligraphy is also called ‘Silent Music’.¹ Contemporary Chinese Calligraphy has detached itself in the past 25 years from the practice of writing signs, in order to explore graphical and painterly processes. Yet it remains beholden to the materials, techniques, and attitudes given by tradition and culture.

The combination of calligraphy and music represents a traditional practice, since the literati (the high class of cultural practitioners) were supposed to also be consummate players of the Qin (Ho, 1997). Even today, calligraphic performances are carried out with accompaniment by traditional Chinese music, and more recently also pop-styles (mainly in Korea).

In the fields of digital music and new interfaces only a few approaches combining calligraphy and music have been documented. This may be due to conceptual challenges as well as the technical hurdles. Linking calligraphy and music through technical means has been explored by combining stroke classification systems with musical elements and symbols. This is used in one case to generate musical pitch classes for playing conventional notation-based music (Huang et al., 2012) and in another case for the development of musical interfaces (Kang and Chien, 2010). In each case the points of reference are calligraphic gestures with the conventional stroke and sign patterns of writing actual characters. In the Movement and Computing field, graffiti strokes have been formalised, to be synthesised by machines (Berio et al., 2017).

In this article we address an augmented calligraphy performance mode encountering an idiosyncratic musical style.

¹Zhang Quiang in a private, translated conversation, April 2018.

Gesture and Sound

Linking two practices of gesture-based art forms is a process of translation – one of discovering common elements. The process of mapping (Arfib et al., 2002) is used to establish a link or relationship between two domains, via an intermediate layer and shared objects, so-called Boundary Objects (Star and Griesemer, 1989) that enable negotiation between the domains. The process of translation needs to take into account the specifics of each domain and creates a third, blended space of signification (Fauconnier and Turner, 2003). Working with sound and digital processes, the target domain carries principles of sound production, propagation, and perception. It also entails procedural processes (sequential or concurrent processing) and a parametric space of control (Hunt and Kirk, 2000).

The phenomenon of gesture originates in the physiological ability of action provided by our bodies. A gesture is an action carrying semantic content, i.e., expressive, narrative, and functional, and is originally related to speech and linguistics (Kendon, 1997).

Expressive gesture in the performing arts, however, is often characterised in terms of movement qualities (Schacher, 2018), effort (Davies, 2007), somatic affect (Kozel, 2013), and effect (Massumi, 2002). Musical gestures and their relationship to sound production provide a rich field of investigation, with classifications in body-related (Cadoz et al., 2000) as well as semiotic (Delalande et al., 1996) and pragmatic domains (Jensenius et al., 2010). In music psychology there is a consensus that the combined perception of gesture and sound is based on the sensorimotor and motor-mimetic capacities of human perception (Godøy, 2003). “The motor-mimetic perspective on music [leads us] to think of music as multimodal combination of gestures and sound, and to always look for gestural schemas in musical sound” (Godøy and Leman, 2010, p. 110).

Taking these perspectives into consideration, the combination of gesture performance with sound represents something else than sonification (Hermann et al., 2011). Sonification aims at using the auditory sense to provide different accesses and methods of analysis to data.

On a conceptual level, the domains of gestural music and sonification share physics and parameter spaces. The specificity of gesture, however, is that the origin of data lies in the human body and its motivation and effect arise through human cognition *and* culture. The extension of gesture with sound is therefore more than a measurement method for obtaining motion data. It represents a reconstruction of multi-modal gestural units that refer to modes of perception associated (recoded) with actions and objects that effectively produce sound (Godøy, 2006, p. 155).



Figure 1: Marker placement on arm, hand & brushes (left) and two-person performance with motion capture (right).

Intersubjective Ink

The project ‘Bi-Face Graphy’, by Zhang Quiang and Lia Wei (Wei, 2018, p. 61) is a two-person Calligraphy performance on a free-hanging, open scroll of silk. The two artists stand on opposite sides of the silk scroll and perform the painting with brush and ink. They interact through the brush strokes that are the only visible elements perceivable through the silk scroll. Occasionally they congregate on one side of the scroll to discuss the results achieved and the type and placement of coming actions.

This performance practice and style is highly idiosyncratic. Usually, experiments in modern calligraphy do not really question the divide between arts of the brush and craft. Instead, located somewhere between the deconstruction of characters and abstract expressionism, contemporary calligraphy carries with it the de-materialising and de-contextualising effect of the Modernist white box. The ‘Biface Graphy’ project starts from the premise that calligraphy, if it is to be transformed, needs to re-negotiate its relationship with painting, but also with epigraphy, rubbing, seal carving, etc.

Modern calligraphy remains caught in a highly individual conception of the artist. ‘Biface Graphy’ wishes to replace the figure of the calligrapher by dual subjects. This intersubjective dimension furthers a dialogue with the divine, the natural environment and the viewers of epigraphy and calligraphy. The aim here is to go beyond individual enunciation, or even subjective enunciation, and to look for the necessary social content of enunciation (Deleuze and Guattari, 1980, p. 101) (see also (Wei, 2018)).

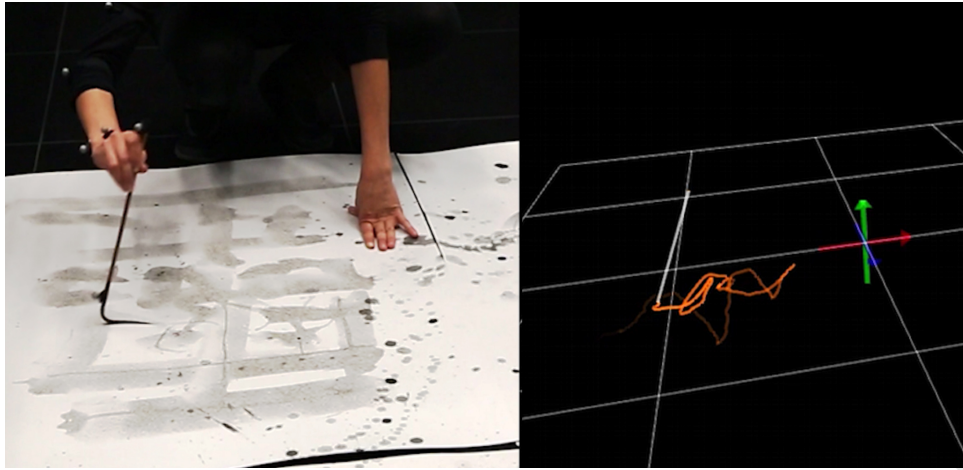


Figure 2: Motion capture of a conventional calligraphic action by one person; the canvas lies flat and the brush is held vertically.

Stroke

In a conventional interdisciplinary encounter between calligraphy and music, both disciplines are performed in parallel by two distinct artists. In contrast, in the current configuration, a link is established by technically linking stroke movements to digital sound processes without intervention by an additional performer. The goal is to let the sounds follow and express directly the brushing gestures of the performers; through this juxtaposition, the calligrapher-as-performer takes on a dual role of a musical as well as inking performer. This connection creates a mixed form of performance, which has the potential to bring to the surface the underlying movement- and gesture-dynamics shared between music and calligraphy.

For the experimental live-performance of calligraphy linked to electronic sounds, it is necessary to implement a technical process that enables the connection of the physical brush-strokes to electronic sound processes. The aim was to gather experiences about the calligraphic process and the specific challenges posed by the unique setting of a 'Biface-Graphy' performance. This collection session with short exemplary performances was carried out under laboratory conditions and provided the source material for investigating different techniques of linking the movement traces to a sonic or musical form.

Capture

In order to investigate the links and potentials of calligraphic performance with sound, a motion capture of this specific practice was carried out (see Fig. 1 left).² After an introductory exchange about calligraphic materials, techniques, and processes, we engaged in performing short sequences of calligraphic performance on two sides of a hanging silk-scroll.

The motion capture system, consisting of 11 cameras running at 100 Hz,³ was setup in an overlapping dual cube configuration around the centrally placed scroll (see Fig. 1 right). Markers were placed on the performer's right arms and hands, the brushes' tips and ends, as well as the edges of the silk scroll (canvas).

During the capture session, five usable datasets were gathered that represent two characteristic modes of calligraphic performance. The captured datasets last from around 30 seconds to more than six minutes and are of varying complexity. In order to provide a *baseline*, a simplified configuration with a single brush in the conventional calligraphic attitude was recorded: one person draws on a flat canvas with the brushstrokes descending from above (see Fig. 2).

Three datasets of two-person calligraphy performances were collected, where different dynamics, brushes, and placements of a hanging silk-scroll were carried out. With water at first and later ink, the successive performances created an increasing density of the visual field and had a notable influence on the stroking actions (see Fig. 3, left half and Fig. 8).

The motion-capture process was complemented by reference-video and audio recordings, which allowed to reconstitute as much of the actual situation as possible.

In any marker-based capture situation, the constraints of the available equipment and the physical setting make it challenging to obtain marker data without occlusions and drop-outs. In this case, for example, where an arm-gestures was folded inward towards the scroll and the brush tips pushed into the silk, the important markers on the shoulders got occluded and led to a loss of tracking.

Therefore, data cleaning and trajectory reconstruction processes were necessary, in order to obtain uninterrupted stroke data. In lab-situations where the data is analysed at a later time this is a standard procedure. In real-time applications, however, for example in a staged performance, this poses a considerable problem.

It is noteworthy that at this stage in the process no sound was added, thus keeping the capture and its experience by the performers close to its original state.

²For videos and supplemental materials of this project, visit <http://movementxsound.zhdk.ch/calligraphy.html> or watch: video_1; video_2; video_3; video_4 (all URIs accessed in August 2019).

³<http://optitrack.com/products/flex-3/>

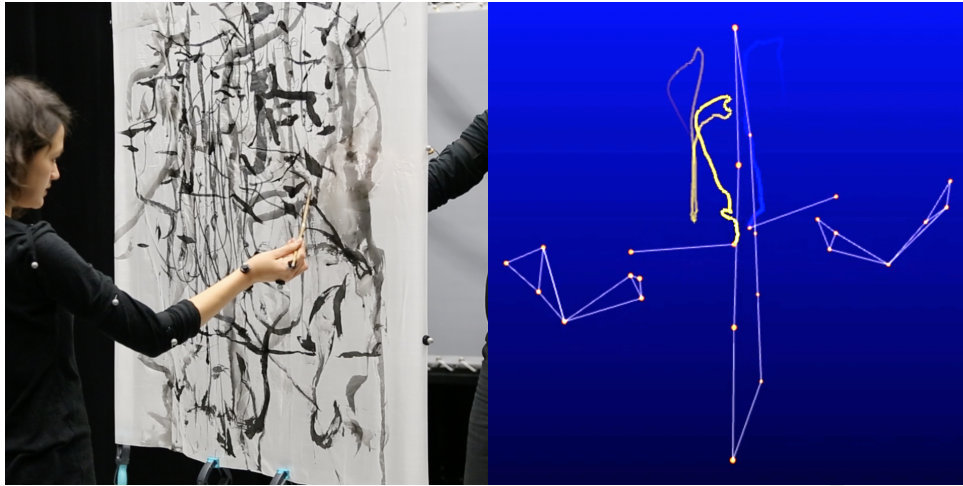


Figure 3: Motion capture trace of a two-person calligraphic performance on both sides of a hanging scroll. The marker visualisation (edge-on) shows the scroll's edges, the arms and hands as well as the brush sticks. The active part of the brush, its hair, extends from the marker at the tip.

Configuration

After cleaning and preparing the data-sets the actual work with sound can begin.⁴ The first step is the elaboration of an initial configuration and connections in software for real-time playback of the captured data coupled with the audio/video recordings. The main task is to develop a coherent model of stroke-gesture to sound translation.

Technically, the process of generating sound from gesture data uses well established methods: in our case, software written in openFrameworks (oF)⁵ is used to process and play back the data-sets. It provides an OSC-stream that carries time-stamps, marker-positions, and their pre-calculated first to third order derivatives. The sound-engine is made in MaxMSP,⁶ and uses custom externals for statistics analysis.⁷ The sound engine implements different synthesis and playback processes, particularly the IRCAM tools for concatenative sound synthesis.⁸

The starting point of the musical process is the decision to augment the brushstrokes with natural sounds instead of synthesised sounds.⁹ For the current exploration two types of sound

⁴The files are formatted as tab-separated-values with headers corresponding to the Mocap Toolbox (MTB) specification (Burger and Toiviainen, 2013)

<https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mocaptoolbox>

⁵<http://www.openframeworks.cc>

⁶<http://www.cycling74.com>

⁷Using objects for streaming and statistics from <http://www.jasch.ch/dl/>

⁸<http://ismm.ircam.fr/catart/>

⁹The boundary between synthesis and natural sound-processing is arbitrary, since granulation is also consid-

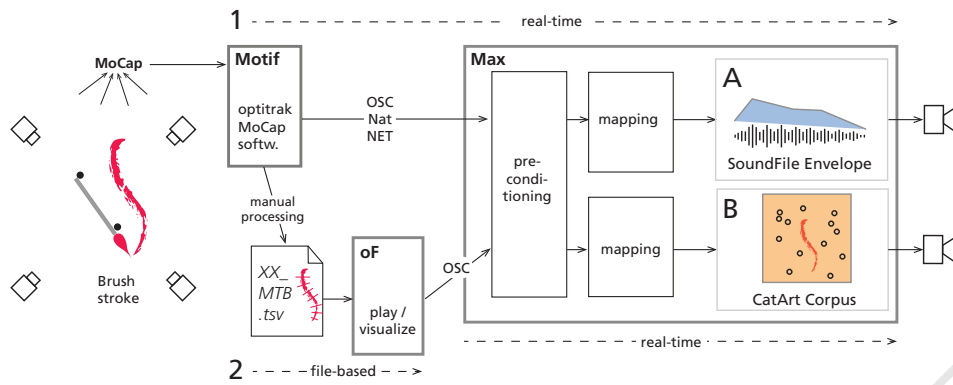


Figure 4: The flow of information from brush-stroke to sound-processes. Note the two routes, either 1) real-time or 2) file-playback, both leading to two sound-processes, A) the gesture trajectory as envelope for a sound-file, and B) the gesture path serving as cursor for navigation inside a CatArt corpus.

materials were chosen: classical string instruments' bow strokes with extended playing techniques and asian bamboo-flutes with air and breath sounds. Both materials contain an element of noise or air sound in addition to providing pitched modulated and timbrally rich sounds. The organic and timbral character of the sounds produces a sonic analogy to the textured ink traces left by the brush on silk. Therefore, instead of working on a discrete, symbolic level with musical events such as notes, pitches, and rhythms, the organic sounds combined with continuous controls allow for a fluid sound language to emerge.

Process

Based on this premise, two concepts for producing and controlling sound are implemented (see Fig. 4).

These processes are:

- A) Amplitude-controlled playback of complete sound-phrases of a longer duration, reflecting the dynamics of the stroke gesture.
- B) Sound textures that evolve in the dynamic shape of the stroke, accessing a pool of different sounds through granular techniques (CatArt).

The first, onset-based model has the advantage of providing coherent dynamic shapes with a longer sonic phrase, which corresponds to single, long brush actions with an full load of ink. Here, combining the speed-profile with canvas-proximity calculations allows to shape an existing sonic material with the energy envelope provided by the painting gesture. As the stroke

ered a synthesis method, even if it is based on prerecorded materials.

progresses, so does the sound-material in its naturally recorded form. The perceptual synchrony occurs through a mimicking relationship between movement energy (speed) and sonic energy (amplitude). The temporal coherence fosters the fusion of the visual and the sonic gestures into a single multi-modal unit.

The second, corpus-based granular model, provides two aspects of sound processing; onset synchronisation with key-moments in the sound-corpus and timbral evolution across a set of related sound materials. The evolution of the sound is mapped homogeneously to the physical space of the brush-stroke: the positional data of the motion-captured brush is used spatially navigating within a map of the sound corpus (Schwarz et al., 2006). Concretely, this means that the 2D-position of the brush on the canvas is mapped to a 2D-representation of the corpus' parameter space. Thanks to this, the speed-profile (first derivative of position changes) is complemented by the acceleration profile, which alters the grain-size of the synthesis algorithm and renders the sonification more differentiated. This technique enables the assignment of specific timbral parameters to specific gestural characteristics of the brush-stroke.

Tests with further calculable movement descriptors, such as the Laban Effort descriptors 'weight-effort' or 'flow-effort' (Larboulette and Gibet, 2015), reveal that higher order interpretations of brush-point data yield no significant increase in perceptual coherence.

One future avenue to investigate is the implementation of spectral decomposition of the movement data in order to isolate minute movement components from larger gesture arcs. These might be relevant to brushing techniques, and would allow to obtain views on the data in time-frames of different orders of magnitude (Burger and Toiviainen, 2013).¹⁰

Unit

As is the case with any gesture data analysis, the central issue in generating analogous sound-'Gestalts' lies in understanding where a gesture unit begins and where it ends, in other words, *what is a stroke?*

For the human eye, this question might already be complex to solve. For an algorithm, this is a *hard* problem.

In the case of calligraphy, there are some obvious elements to a stroke, related to applying ink to the surface. In a simple model, all the preparatory movements with the brush can be eliminated. Only when the brush-hair actively touches the silk and blackens it, a stroke is being applied.

¹⁰The caveat here is that there currently exists no usable real-time implementation outside of Matlab.

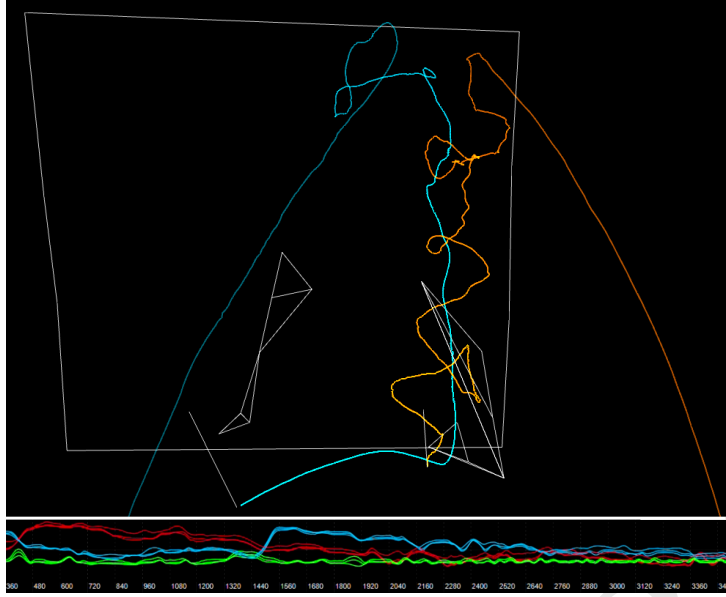


Figure 5: (Top) Spatial motion visualisation of two brush-tips executing an entire phrase from ink-pickup to ink-pickup. The right, orange trace is the expert’s brush stroke. Notice the access arches of the brush tips and the outlines of arms, canvas and brushes (angular in grey). (Bottom) Temporal motion graph of a group of markers, clearly showing the large phases and the smaller oscillations of individual strokes or phrases.

This information can be approximately obtained from observing the brush crossing a distance threshold to the canvas (see Fig. 6).¹¹

In the case of a flat and solid painting surface such as in the base-line performance, this threshold is a numeric value that represents the maximal distance of the brush-tip where the brush-hair can still produce a mark on the canvas. This gets more complex in the case of the hanging scroll with opposing performers, because the hanging scroll moves back and forth as it is pushed by the opposing brushes.

Here, an approximation can be established by calculating the position of the brush’s contact point in relation to the canvas edges (see Fig. 6). However, this provides merely a rough approximation, since the silk material deforms within the surface without reflecting this on its edges. To obtain more precise brush contact data, using a point-cloud from a depth-camera or higher resolution model of the canvas surface would be necessary. This would require different technical solutions to be added to the capture setup.

The second way stroke segmentation information can be obtained is by analysing the speed

¹¹An advanced technique involving computer vision could help in that regard, provided the occlusion problem can be solved.

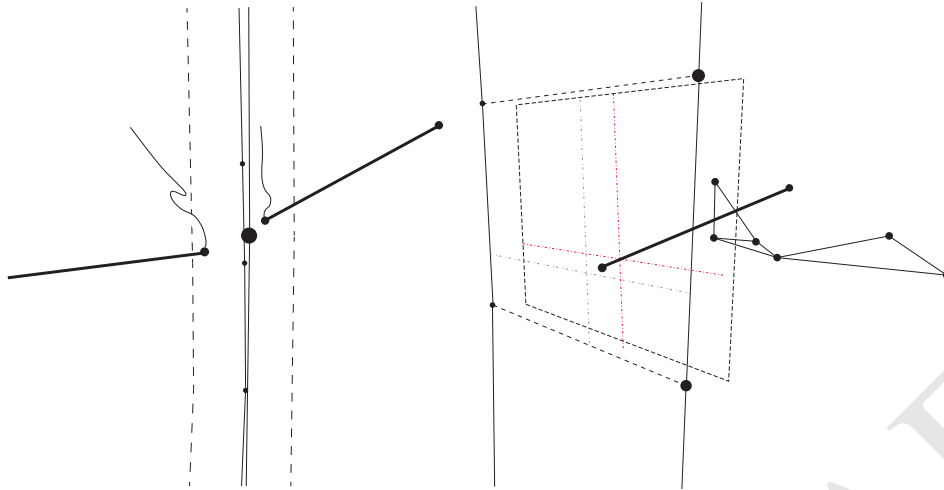


Figure 6: Distance detection on the hanging silk scroll: the position with regard to the surface is calculated in relation to the edges of the canvas. Edge on view (left) and perspective view (right).

profiles of the brush-tips. The zones with a longer timeframe of deceleration and very low speed indicate a stopped brush. As with speech or movement analysis of dancers, for example, the problem here is co-articulation, where one movement unit (or in the case of speech, a phoneme) seamlessly glides into the next unit, thus providing no clearly discernible limit between the two. This, again, is a *hard* problem for movement analysis, or analysis of organic gesture trajectories in general.

For more precise segmentation, other, more sophisticated algorithms need to be used. Training a machine learning regression model with hand-to-brush postures combined with acceleration and rotation profiles is one putative method, to be further explored.

For the present project, the determination of distance-thresholds and speed-profiles methods were deemed sufficient to provide segmentation.

The expressive qualities of calligraphic strokes occur in a different dimension than those of a musical instrument performance. When the sonification is to be heard detached from seeing the brush-stroke, the particular timing and dynamics become evident. Only with the two modalities present at the same time, does the augmentation of the latter with the former make sense.

Shape

The central intention of this investigation is to provide *methodological insights* that can guide coming configurations. By adding a reflective layer, the arrangement of the basic building blocks and the issues found are put into perspective.

The work carried out thus far permits the articulation of a few core questions concerning cross-disciplinary translation, gesture-sound translations, and cross-cultural encounters.

Questions raised by this approach are:

- What type of experience does this cross-disciplinary and cross-cultural approach generate?
- What type of (tacit (Polanyi, 1967)) knowledge can this combination bring to the surface?
- How does a translation mediate between an interpersonal calligraphic performance with its tradition, biography and a contemporary technological practice?
- What are the referents and perceptual modes engaged in this translation?
- Is legibility of each practice the aim, or the is the creation of a non-defined, novel juxtaposition sufficient?
- Are the intentions, expressions and affects of this extended practice universal and transposable from one cultural context to another?

At this stage of the process, a proof of concept has been established that can provide the basis for further implementations in different performance contexts. More importantly, however, is the possibility to carry out a reflection that arrays all of the components of this process, its contexts and backgrounds, and attempts to tease out possible connections and insights. A practical approach to understanding the relationship between the domains is to carry out a diagrammatic reading. In laying out elements and actors of the configuration on a map, they become visibly related and their relationships can be established.

Dia-Gramma

Music exists at the intersection of organised sounds with our sensorimotor apparatus, our bodies, our brains, our cultural values and practices, music-historical conventions, our prior experiences, and a host of other social and cultural factors. (Johnson, 2007, p. 255)

We can take Johnson's perspective about our embodied and intertwined relation to body and culture in music as a starting point. It presents a possible way to investigate the topic at hand, by unfolding the elements from the involved domains and setting them side by side.

In the diagram presented here (see Fig. 7), the global conditions for performing sound-augmented calligraphic painting are arranged on the outer, larger frame of the map: We find that calligraphy is a deeply *cultural* activity, carrying with it the weight of tradition and the richness of practice and skill developed over extended periods of time. Music as well carries a core element of cultures, probably going farther back, even, than recorded history. Electronic music *practices* are also carriers of culture, albeit in a scope that radically differs from its

counterpart, because this musical approach is neither at the core and therefore iconic for a culture, nor does it bear the long tradition with it: it rather represents a singular possible stream in contemporary musical practices. Nevertheless, this *discipline* shares with ink arts the need for *materials* and tools, expressed in a specific *configuration*. Both can be perceived as domains of *action*, even if sound in its digital production mode does not necessarily have any tangible forms. However, in the present linked *relationship*, the dominant *linkage model* is that of synchronous evolution, attempting to generate a fusion of the perceptual object.

Along the inner orbit, the concrete elements of the practice, the *stroke* as *gesture* working with *ink/silk* and *sound* are grouped in mirrored position around the central notion of *dynamics*. Both disciplines are focusing on *performance* and in themselves already effect a *translation* from inner forms to outer manifestations in stroke or sound. Between them an equivalence is postulated between a sign and a musical phrase, their energy trajectories and spatial shapes reflecting the underlying *dynamic* movement and gesture prototypes ('Gestalt'-units (Katz, 1950)) provided by imprinted body-schemata and body-images (Gallagher, 2005, p. 24). As Johnson's quote above relates, embodied aspects of our sensori-motor capabilities form a foundations of perceiving meaning in movement forms.

Arriving at a symmetrical arrangement of the elements in the diagram suggests that the two source domains correspond to each other; it is more difficult to represent where the two areas do *not* match. This is a difficulty in any inter-disciplinary encounter; their blended space (Fauconnier and Turner, 2003) creates a new zone of convergence but excludes previously important aspects. As an example: the autonomy of the musical form versus the graphical gesture is lost; the shift to a hard-linked interdependency leads the performers to be responsible both for the visual and the aural dimension of the performance. Another area that is difficult to reconcile is the goal oriented nature of a painting performance, which creates a tangible, lasting artefact, whereas the sound-domain weaves a fleeting, ephemeral texture that arises only in the perception and experience of those physically partaking in the performance.

Equivalence

The musicality of calligraphy gets expressed through the rhythms, phrasings, as well as the responses in 'polyphonic' stroke gestures. On a more fundamental level they seem to originate in the kinaesthetic patterns and movement forms that the calligraphers express through their gestures. Writing and painting strokes serves as a conduit for physical expression, be it in traditional calligraphy or contemporary forms of post-calligraphic performance.

The enactive perspective allows us to think of gesture as an corporeal unit that is universal

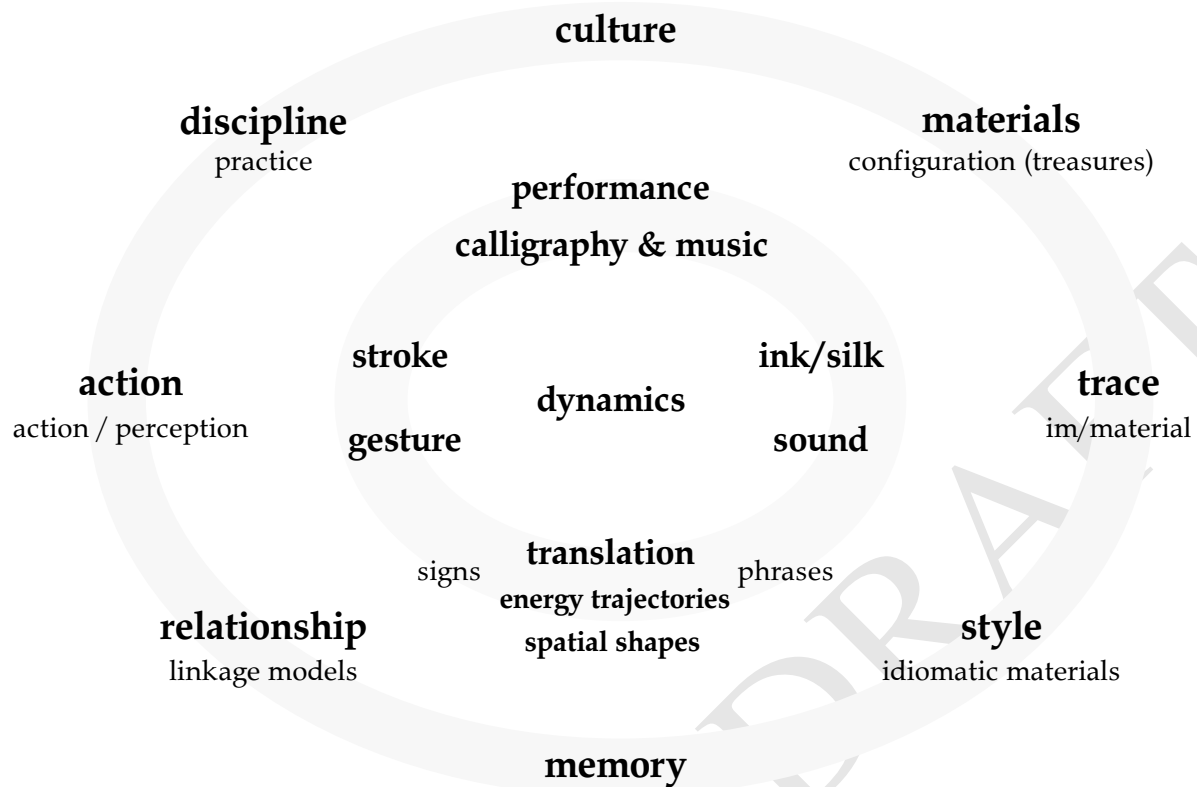


Figure 7: Field diagram of elements involved in translating between calligraphy and music. Arranged around the basic phenomenon of dynamic shapes in fluid temporality, the inner circle shows the immediately active, the outer circle the fundamental elements. This typology is used to guide artistic choices.

and expressed within its context of application (Varela et al., 1991; Gallagher, 2005; Noë, 2004). The relation between sensory experience and movement, mediated by skillful use of implicit, practical, non-propositional knowledge generates primary perceptual experiences.

Taking music as a starting point for a reflection about equivalence between the two disciplines might help make the similarities and common ground shared by music and calligraphy clearer. The physical actions of performing music on the instrument and the control over the instrument and one's body occur predominantly in the pre-reflective domain. The performative action is guided by motor patterns and body-schematic elements that are acquired as part of extended training and practising. Thus, the specific controls of the body parts necessary to produce, sustain, and expressively control sound are all integrated on a level below conscious control: "expressive movement ... is necessarily embodied, enabled and at the same time constrained in specific ways by the structure and performance possibilities of the motor system." (Gallagher, 2005, p. 146)

Furthermore, in music as well as calligraphy performance, techniques and tools come into play, where it is not just the body-environment relationship, but also the *body-tool-culture* relationship that informs the effectiveness of an action, in this case the stroke-gesture with ink.

The brush stroke on paper/silk is a trace of an action and the target of the artist's intention. For the viewer, this action remains visible through a physical resonance that knowledge of the technique, even in a minimal sense, produces. The stroke resonates within the viewer. The ink acts as a condensate of the gesture, much as the sounding event acts as the conduit for the energy of the playing. Traditional instruments have this legibility given by culturally shared knowledge of how instruments are played: drums are hit, flutes are blown, strings are bowed, etc. Electronic sound processes lack this characteristic, which gives them greater malleability and makes them suited for the fusion with brushstrokes.

Exposure

All the elements brought together in this project have been used to *augment* the basic model and make it workable. But does it really work?

To better understand how well this model works, the results were shown to an audience of European and Chinese scholars as well as contemporary Chinese ink artists.¹² The claim presented was that dynamically synchronised sounds with a brush-stroke's speed-profile generate the sensation of a fused, multimodal perceptual object. The critical dialogue with these experts brought to the foreground a number of fundamental issues evoked by this approach.

In addition to questioning the necessity for such an augmentation, the discussion evolved around the differences between the disciplines, both culturally and technically, and the way the link is established.

On a methodological level, the main problem is the paucity of data-dimensions of the movement-to-sound link. Even if measuring kinematic trajectories of bodies in space succeeds, this data contains by no means any information about the quality and style of the brush-stroke. This is relevant because, as stated by Prof. Zhang Quiang, it is to the ink trace that all the focus and attention goes, not to the gesture producing it.

Furthermore, there is the difficulty of creating a meaningful *sonic sibling* to the brush gesture. What sounds are useful to extend the brush stroke? The choice of sound-material and the mapping of gesture characteristics to this model can dramatically alter the outcome. The

¹²This discussion occurred in the context of the first ink art week that took place at the Ca'Foscari University of Venice in April 2018. The catalogue and programme of this gathering can be found here: https://www.academia.edu/36534484/Ink_Art_Week_Venice_Catalogue.



Figure 8: Strokes, resonating. Detail of the canvas after the performance exemplifying texture and shape of the brush-strokes. The richness of detail in the ink and overlapping shapes generated by the performance demonstrates the distance to be bridged between calligraphic and sound techniques.

sound materials that were chosen, for example, carry too much cultural agency of their own, either evoking contemporary European ‘new music’ or a romanticised ‘Eastern’ flavour.

Taking these issues into account, the overall agreement between the artists, experts and audience who saw and heard the combined results, is that this combination produces an *unexpected* and refreshing take on the question of music and calligraphic performance.

Apart from the impression of fusion of the two dimensions, the stronger impact is that the act of performing with ink in a sound-coupled manner gains a more immediate sense and lets it be perceived as an autonomous act rather than merely the process aimed at producing an ink art artefact.

The practitioners of contemporary calligraphy were more critical, acknowledging the large gap both on a craft and on a cultural level.

Following Traces

At this stage, the artistic goal of augmenting calligraphic performance with dynamic sound-generation is reached to some extent. We need to explore and perform with more ways of augmenting calligraphic performance. First, in order to help the calligrapher tame the dual tasks of simultaneously stroking sound with ink, or no ink at all, or even virtually projected ink. And second, to get a firmer grasp on how to create effective sound-gesture twins.

In addition to investigating the link between ink-strokes and sound, this collaboration addresses further urgent issues of a different nature: Does the juxtaposition and fusion of two cultures, two disciplines, and two specific artistic practices lend itself to generating a field of understanding of an underlying common dimension? How can we communicate when mixing our practices? And can we thus circumvent the misunderstandings and misapprehensions that generally permeate cross-cultural encounters? In that sense, finding a pair of idiosyncratic calligraphers, who are willing to experiment in novel, hybrid forms of performance, to support an inquiry into the nature of fundamental gesture units and their affective power is a real gift.

So, let us ask again, what is a stroke?

On a primary level, in calligraphy, a stroke is a movement unit with a brush, a graphical unit on the canvas. In the configuration presented here, a stroke is a sonic unit resounding both physically (the sound of brush on silk) and virtually (the translated sound of a brush-stroke in dynamically generate sound). In music, a bow-stroke on an instrument produces a sound-event (one or several tied notes).

What is more important, however, is the perceived unity of a stroke. Even if a stroke consists of several units, what is perceived is the intent of the action, the dynamics and intensity of execution of the action, and finally the result of the action.

The original intuition that a brush-stroke and a bow-stroke are equivalent can be affirmed. Their source flows from the same physiological, perceptual, and enactive fundamentals, their affective and effective force is based on the same principles of ‘Gestalt’-perception, which lets the viewers and listeners *resonate* in the same way. This kinship is buried beneath layers of cultural, disciplinary, and stylistic differences, which have obscured the precedence and power of the common impulse that moves us all.

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References

Daniel Arfib, Jean Marc Couturier, Loic Kessous, and Vincent Verfaillie. Strategies of mapping between gesture data and synthesis model parameters using perceptual spaces. *Organised Sound*, 7:127–144, 7 2002. ISSN 1469-8153. doi: 10.1017/S1355771802002054.

Karen Barad. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press, Durham, NC, 2007.

Henri Bergson. *Matter and Memory*. George Allen and Unwin Ltd., London, UK, 1911.

Daniel Berio, Memo Akten, Frederic Fol Leymarie, Mick Grierson, and Réjean Plamondon. Calligraphic Stylisation Learning with a Physiologically Plausible Model of Movement and Recurrent Neural Networks. In *Proceedings of the 4th International Conference on Movement and Computing (MoCo'17)*, number 25, page N/A, London, UK, 2017. Goldsmiths, University of London.

Birgitta Burger and Petri Toiviainen. MoCap Toolbox-A Matlab toolbox for computational analysis of movement data. In *10th Sound and Music Computing Conference, SMC 2013*, pages 172–178, Stockholm, Sweden, 2013. Logos Verlag Berlin.

Claude Cadoz, Marcelo M Wanderley, et al. Gesture-Music. In *Trends in Gestural Control of Music*, pages 71–94. Ircam, Centre Pompidou, Paris, France, 2000.

Eden Davies. *Beyond Dance: Laban's Legacy of movement Analysis*. Routledge, New York, NY, 2007.

François Delalande, Marcel Formosa, Marcel Frémiot, Pascal Gobin, Pierre Malbosc, Jacques Mandelbrojt, and Emmanuel Pedler. *Les Unités Sémiotiques Temporelles - Éléments nouveaux d'analyse musicale*. Édition MIM, Marseille, France, 1996.

Gilles Deleuze and Felix Guattari. *Mille Plateaux, Capitalisme et Schizophrénie 2*. Editions de Minuit, Paris, France, 1980.

Gilles Fauconnier and Mark Turner. *The Way We Think: Conceptual Blending and the Mind's Hidden Complexities*. Basic Books, New York, NY, 2003.

- Paul Feyerabend. *Against Method: Outline of an Anarchistic Theorie of Knowledge*. University of Minnesota Press, Minneapolis, MN, 1970.
- Shaun Gallagher. *How the Body Shapes the Mind*. Clarendon Press, Oxford, UK, 2005.
- Rolf Inge Godøy. Motor-Mimetic Music Cognition. *Leonardo*, 36(4):317–319, 2003.
- Rolf Inge Godøy. Gestural-Sonorous Objects: Embodied Extensions of Schaeffer’s Conceptual Apparatus. *Organised Sound*, 11(2):149–157, 2006.
- Rolf Inge Godøy and Marc Leman. *Musical Gestures: Sound Movement and Meaning*. Routledge, New York, NY, 2010.
- Thomas Hermann, Andy Hunt, and John G. Neuhoff. *The Sonification Handbook*. Logos Publishing House, Berlin, Germany, 2011.
- Edward Ho. Aesthetic Considerations in Understanding Chinese Literati Musical Behaviour. *British Journal of Ethnomusicology*, 6(1):35–49, 1997.
- Michael Xuelin Huang, Will W. W. Tang, Kenneth W. K. Lo, C. K. Lau, Grace Ngai, and Stephen Chan. MelodicBrush: A Novel System for Cross-modal Digital Art Creation Linking Calligraphy and Music. In *Proceedings of the Designing Interactive Systems Conference, DIS ’12*, pages 418–427, New York, NY, USA, 2012. ACM. ISBN 978-1-4503-1210-3. doi: 10.1145/2317956.2318018. URL <http://doi.acm.org/10.1145/2317956.2318018>.
- Andy Hunt and Ross Kirk. Mapping strategies for musical performance. In M. M. Wanderley and M. Battier, editors, *Trends in gestural control of music*, volume 21, pages 231–258. IRCAM, Centre Pompidou, Paris, France, 2000.
- Tim Ingold. Bindings against Boundaries: Entanglements of Life in an Open World. *Environment and Planning A: Economy and Space*, 40(8):1796–1810, 2008.
- A.R. Jensenius, M. Wanderley, R.I. Godøy, and M. Leman. Musical Gestures, Concepts and Methods in Research. In R-I Godøy and M Leman, editors, *Musical Gestures, Sound, Movement and Meaning*. Routledge, New York, NY, 2010.
- Mark Johnson. *The Meaning of the Body, Aesthetics of Human Understanding*. The University of Chicago Press, Chicago, IL, 2007.
- Laewoo Kang and Hsin-Yi Chien. Hé: Calligraphy as a Musical Interface. In *Proceedings of the Conference on New Interfaces for Musical Expression*, pages 352–355, Sydney, Australia, 2010. UNSW.

- D. Katz. *Gestalt Psychology, Its Nature and Significance*. The Ronald Press Co., New York, NY, 1950.
- Adam Kendon. Gesture. *Annual review of anthropology*, 26(1):109–128, 1997.
- Susan Kozel. Somatic Materialism or "Is it Possible to do a Phenomenology of Affect?". *Site Magazine*, 1(33):153–167, 2013.
- Thomas S Kuhn. *The Structure of Scientific Revolutions*. University of Chicago Press, Evanston, IL, 2012.
- Caroline Larboulette and Sylvie Gibet. A Review of Computable Expressive Descriptors of Human Motion. In *Proceedings of the Second Workshop on Motion and Computing MOCO'15*, pages 21–28, Vancouver, Canada, August 14–15 2015. ACM.
- Brian Massumi. *Parables for the Virtual: Movement, Affect, Sensation*. Duke University Press, Durham, NC, 2002.
- Alva Noë. *Action in Perception*. MIT Press, Cambridge, MA, 2004.
- Micheal Polanyi. *The Tacit Dimension*. Routledge and K. Paul, London, UK, New York, NY, 1967.
- Jan C. Schacher. What Quality? Performing Research on Movement and Computing. In *Proceedings of the 2018 Conference on Movement and Computing (MoCo'18)*, pages 1–8, Genoa, Italy, June 2018. ACM.
- Diemo Schwarz, Grégory Beller, Bruno Verbrugghe, and Sam Britton. Real-time corpus-based concatenative synthesis with catart. In *9th International Conference on Digital Audio Effects (DAFx)*, pages 279–282, Montreal, Canada, 2006. McGill University.
- Susan Leigh Star and James R Griesemer. Institutional Ecology, Translations and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19(3):387–420, 1989.
- Isabelle Stengers. *Cosmopolitics I*, volume I, II & III. University of Minnesota Press, Minneapolis, MN, 2010.
- Francisco Varela, Evan Thompson, and Eleanor Rosch. *The Embodied Mind: Cognitive Science and Human Experience*. MIT Press, Cambridge, MA, 1991.

Lia Wei. Epigraphy in the Landscape: Intersections with Contemporary Ink Painting and Land Art. In Huang Liang, editor, *Ink Art Week: An International Platform for Contemporary Ink Art Research, Experimentation and Discussion*, pages 41–70. Culture and Arts Publishing House, Beijing, China, 2018.