# NON-THINKING MUSIC MAKING: A PROPOSED METHODOLOGY TO EMANCIPATE IMPROVISATION

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***Abstract:***

**This paper draws on discourse from psychology, cognitive science and neuroscience to present a theoretical framework with which to explore procedural memory, readiness potential, intentional binding and hypnosis as a means of developing points of intervention in the reflexive/volitional behaviour of an improvising musician. It proposes a methodology to invoke the cognitive state of hypnagogia and in so doing create an environment for emergent behaviour to become manifest within the context of musical/sound art improvisational performance. The paper will outline experimental collaborative work with musicians, technicians and professionals from the field of clinical hypnosis. Biofeedback is often utilised for artistic endeavours in order to provide a data stream, with which to drive algorithms, in a parameter space which produces an artistic output. The methodology suggested in this paper, uses a form of biofeedback (EEG) mediated through hypnotic induction, which can be utilised to augment the parameter space of live performance. This is not as a means of controlling external processes but as a mechanism to influence and augment the performer's behavioural pallet, both within and without conscious awareness. The inspiration for this work is derived from the experiences of leading improvisers and so the project output will be evaluated from the perspective of the performer's subjective experience. This paper maps the theoretical territory from which this creative endeavour has been developed and provides a rationale prior to the work being undertaken.**

## 1. INTRODUCTION

This paper will outline proposed experimental work to be undertaken in collaboration with musicians and professionals from the field of clinical hypnosis. This multidisciplinary paper draws on psychology, cognitive science and neuroscience to explore musical improvisation from the perspective of the performers' perception. The rationale for the experimental work is proposed from the perspective of an improvising instrumentalist striving to explicate their art in a manner which satisfies their desire to create a unique musical performance and which minimises a mechanical form of musical behaviour that utilises pre-programmed units of musical material. Viewing musical improvisation as an activity which competes for cognitive resource alongside all other human undertakings, this paper explores the various limitations which affect a musician's perception of their performance and what form of intervention exists to facilitate their aspirations. The intervention suggested is based on research into the use of the alpha/theta protocol in non-improvised musical performance augmented by techniques from clinical hypnosis.

## 2. REFLEX AND VOLITION IN IMPROVISATION

Musicians spend many hours encoding motor skills in order to give access to a wide range of functionality over their instrument. Through precisely controlled repetition, instrumental facility can be encoded in implicit procedural memory. This slow and cognitively demanding encoding process requires focused attention to develop fine motor skills, particularly at the outset. As the process of encoding develops over a period of time the cognitive burden of accessing the stored functionality is lessened and efficiency gains start to accrue. As William James notes in his seminal psychological text, "Habit diminishes the conscious attention with which our acts are performed". [1] In terms of brain anatomy, an important area for the regulation of procedural memory is the striatum, which helps coordinate motivation with body movement and is the primary input to the basal ganglia. Using inputs from other parts of the brain the basal ganglia, controls voluntary motor movement, procedural learning and routine behaviours or 'habits'. Two other important areas in regard to procedural memory are the cerebellum, associated with the fine-tuning of motor skills through adaption and correction, and the limbic system that interrelates processes involved in emotion, motivation and learning. This is not the place to delve into the low level neurological activity which supports the development and use of a musician's instrumental facility but there is perhaps a need to review certain elements of higher level brain functionality in order to explore their relationship to the metaphors and concepts held by musicians in an attempt to understand their practice.

Once motor skills have been acquired and stored as procedural memories their use or enactment, when initiated consciously, is controlled more as an executive function rather than detailed control over the various elemental components of the initiated action. The acquisition of fine motor skill leads to the development of motor programs stored in the premotor cortex for later activation by the motor cortex. This method of storing units of behaviour is, of course, not confined to a music context and there are many modes available to access and initiate their use. Let's firstly consider musical behaviour as a reflex response to a stimulus before exploring a musician's sense of volitional control and agency.

Research into the nature of reflexes became established in the late 17th century with Willis and Descartes putting forward a dualistic interpretation of cerebral activity as controlling either the mechanistic aspects of human behaviour or the spiritual. In the early 19th century the Bell-Magendie law established a hypothesis that classified all brain functionality as an interface between sensory input and motor output and by the mid 19th century Marshall Hall had developed the idea that the spinal cord is responsible for involuntary behaviours, while the cerebral cortex was responsible for voluntary behaviour. He has been attributed with creation of the term 'reflex arc' and proposed an excito-motor nervous system located in the spinal cord responsible for stimulating highly stereotyped behaviour. Although the concept of a reflex arc is highly relevant today, Hall's hypothesis essentially maintained a dualistic approach which is now rather redundant. As Jonathon Wolpaw states, "the reflex/voluntary distinction derived from the sensorimotor hypothesis of neuroscience is not absolute; all behaviours fall on a continuum from purely reflex to purely voluntary and none is purely one or the other". [2] One of the discoveries which led to the rejection of the dualistic approach to categorizing human behaviour was of the plasticity in the central nervous system. It has been shown that in attempting to induce changes in the reflex responses of primates, even the simplest reflex (spinal stretch reflex, SSR) is susceptible to environmental conditioning. [3] This isn't an influence which can be exerted in the short-term

nor is it consciously controlled but it does indicate that the whole of the reflex/volitional continuum is potentially open to influence given the right situation and time frame. The plasticity of processing a stimulus response in the spinal cord is such that the development of skills requiring sophisticated motor behaviours requires practice over long periods of time. It is obvious that what an improvising musician does in performance is hugely influenced by what they do in the practice room, but this relationship is rarely explored in terms of developing the potential to gain greater access to the quicker, more efficient and more reflexive modes of musical behaviour during performance.

## 3. IMPROVISED PERFORMANCE AND COGNITIVE LIMITATIONS

Behaviours regarded as reflexes tend to be characterised as simple, fast, identically executed and existing outside of conscious control, as opposed to "reactions" which are voluntary responses to stimuli, slower to execute and more difficult to predict. These characteristics do not come close to providing an empirical definition of the terms reflex and volition. In fact Jonathan Wolpaw implied the benign nature of these terms when at the 1998 Neural Control of Movement meeting in Florida he provocatively asked, "are the words reflex and voluntary useful scientific concepts or are they prescientific terms that should be discarded?". [4] Musical improvisation is an interesting domain in which to explore this contentious notion of reflexive and volitional behaviour. Simple and elemental motor skills are compounded into units of musical activity where, for the most part, conscious consideration is given by the performer to higher level musical gestures rather than to fundamental physical actions. It exists within an overt temporal structure, even when the forms of musical expression have stepped outside of our natural inclination towards beat induction. The temporal relationships which exist between individual performers and between performers and their audience provide an opportunity to observe human behaviour which traverses the reflex/volitional continuum.

Consider, that at a moderate speed of 120bpm a performer playing semiquavers is executing notes at a rate of 8 per second or one every 125ms. A competent instrumental improviser could significantly exceed this rate before it became a taxing operation, either mentally or physically. The performer's perception is likely to be that they maintain a complete sense of agency during an extemporisation, as the rate at which they produce musical material naturally and intuitively increases and decreases. However, it seems that individual actions at this speed (semiquavers at 120bpm) exist on the edge of volitional control, despite the perception of the instrumentalist. Pressing identified that "speeds of approximately 10 actions per second and higher involve virtually exclusively pre-programmed actions. An informal analysis of jazz solos over a variety of tempos supports this ball-park estimate of the time limits for improvisational novelty". [5] As speed increases the level of volition afforded by the limits of consciousness diminishes, replaced by learnt material from process memory, streamed via the pre-motor cortex, which is likely to be generic and inevitably much less context specific. Evidence from other fields support this notion of diminished volitional control in human beings when undertaking processes at speed.

An analysis of a hand balancing a stick concluded that the hand movements were so fast that conscious intervention in the process was not possible. 98% of the hand movements required to keep a stick balancing were faster than the 100 milliseconds it takes for a human to respond consciously to a visual stimulus. The compensating movement of the hand comprises a number of small random movements which keeps the stick in a constant state of instability. [6]

## 4. IMPROVISATION, A PERFORMER'S PERSPECTIVE

There is much anecdotal evidence of the inner conflict this realisation creates in improvising musicians. Steve Lacy expresses his frustration at the tendency for improvisatory practice to be comprised of musical units held in procedural memory, "why should I want to learn all those trite patterns? You know, when Bud Powell made them, fifteen years earlier, they weren't patterns. But when somebody analysed them and put them into a system it became a school and many players joined it. But by the time I came to it, I saw through it – the thrill was gone. Jazz got so that it wasn't improvised anymore". [7] Lee Konitz remarks that "playing mechanically suggests a lack of real connection to what you are doing at the moment. We learn to play through things that feel good at the time of discovery. They go into the "muscular memory" and are recalled as a matter of habit". [8]

Procedural memory is however only one dimension to this assault on volition. Activating units of motor activity which comprise musical behaviour maybe something which is perceived as either being under conscious control or not but let us consider the stimulus which causes those units to be activated. Experimental work on reaction times, which started with Wundt in the nineteenth century, has led to the Kornhuber and Deecke discovery in 1965 of a phenomenon they called Bereitschaftspotential (readiness potential). Their discovery suggested that, when undertaking a self initiated act, the brain becomes active anything up to 1.5 seconds before the act is undertaken, in preparation (readiness) for the act to be performed. This research was developed further in the 1970s by Benjamin Libet who set out to see when conscious engagement took place, relative to RP and a self initiated act. Libet discovered that on average readiness potential started 0.55 seconds before the act, while the subject became conscious 0.2 seconds before the act. Libet concluded that "cerebral initiation even of a spontaneous voluntary act of the kind studied here can and usually does begin unconsciously".[9] From Libet's findings it became evident that there is 0.35 second latency (sometimes longer) between the cerebral initiation and conscious initiation of a volitional act. An important phenomenon which comes into play to allow this latency to be mitigated, is intentional binding. Research in this area has demonstrated a difference between a voluntary and involuntary action, in the perception of the time between the act and its sensory consequences. When the act is voluntary there is a perception that the act was later and consequence earlier than reality and when the act was involuntary (induced by transcranial magnetic stimulation) the effect was reversed. [10]

Contrasted with the sense of frustration expressed anecdotally by some improvising musicians at the perceived mechanical aspects endemic in their art form, are the more positive and aspirational sentiments of musicians who have experienced modes of engagement in their practice at the other end of the spectrum. Here Derek Bailey is relaying a different experience to improvisation, which embraces disorientation and distraction as a means of developing methods of provoking novel musical behaviour.

"A lot of improvisers find improvisation worthwhile. I think, because of the possibilities. Things that can happen but perhaps rarely do. One of those things is that you are 'taken out of yourself'. Something happens which so disorientates you that for a time, which might only last for a second or two, your reactions

> and responses are not what they normally would be. You can do something you didn't realise you were capable of or you don't appear to be fully responsible for what you are doing." [11]
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> Evan Parker expresses a positive endorsement of performance contexts with the potential to provoke direct access to reflexive behaviour. He states that "it can make a useful change to be dropped into a slightly shocking situation that you've never been in before. It can produce a different kind of response, a different kind of reaction." [12]

So, what potential is there to construct an intervention in this process to assist improvising musicians to move closer to a playing state where they perceive their musical behaviour to be more unique and less mechanical in nature? An experienced musician practicing in this field is pre-loaded with a pallet of encoded motor skills which are 'chunked' into units of musical behaviour. They have the facility to draw on these elemental motor skills but cognitive limitations restrict their ability to access this pallet at speed and so conscious attention is moved to a higher conceptual level of engagement. The elemental motor skills are accessible as reflexes but these cannot be initiated via the performer's sense of agency. When the performer engages in what they perceive to be volitional musical behaviour, all of their actions and conscious awareness are preceded by cerebral activity but they perceive their actions to be synonymous with their intent. When a performer's musical behaviour is more reflexive, the call to action is more efficient, as it requires less neural activity, even though the performer's perception will be contrary to this. Therefore, the internal dilemma facing the improviser is that they have at their disposal two basic modes of engagement, one where they buy into the illusion of volitional behaviour, which is slow and inefficient or another to resort to executive control and curate their performance from a learned library of material.

## 5. Hypnosis and EEG

Musicians are on occasions afflicted by stage fright and other anxiety related issues. These conditions are, for the most part, driven by an inappropriate subconscious response to a situation, initiated by the primitive brain. One of the most effective treatments for this condition is hypnotherapy. Hypnotherapy provides an intervention in the automatic and template driven mapping of stimulus to human behaviour. The relationship between the brain's interpretation of sensory data and the behavioural response isn't fixed, in fact for good evolutionary reasons it exhibits a type of fuzzy logic that is sometimes known as 'sloppy pattern matching'. An inappropriate behavioural response can sometimes occur if sensory information is incorrectly pattern matched. If hypnotherapy can reduce anxiety in a performer by substituting a defective behavioural template for an effective one, it may also provide a tool for improvisers to explore the reflex/volitional dilemma. In therapeutic contexts the presenting symptomatology is a reasonably clear indication of the underlying dysfunction but in the case of the positive intervention proposed here, the desired cognitive state is not clearly defined. For the purpose of this initial study we have decided to focus on hypnagogia as the target state. Hypnagogia can be broadly defined at the cognitive state which exists between wakefulness and sleep on the transition into sleep, as opposed to a hypnopompic state which is evoked on the transition out of sleep. The effects of hypnagogia have been described for centuries but the term was first coined by the 19th-century French psychologist LF Alfred Maury. Hypnagogia has long been association with creativity and Koestler, in The Act of Creation (1964) documents a substantial amount of anecdotal evidence from artists and scientists who have experienced and embraced this cognitive state. People such as William Blake, Samuel Taylor Coleridge, Edgar Allen Poe, CG Jung, Jean Paul Sartre, Salvador Dali, Andre Breton, Ludwig Van Beethoven, Richard Wagner, Walter Scott, Salvador Dalí, Thomas Edison, Nikola Tesla and Isaac Newton have all reported this psychological phenomena to have had a profound and positive effect on their creativity.

"It is a curiosity of broken sleep that I made immense quantities of verses and that I spoke a certain language, once familiar to me, but which I have nearly forgotten from disuse, with fluency. Of both these phenomena I have such frequent experience in the state between sleeping and waking, that I sometimes argue with myself that I know I cannot be awake" - Charles Dickens [13]

"When I improvise and I'm in good form, I'm like somebody half sleeping. I even forget there are people in front of me." - Stéphane Grappelli [14]

There have been several studies using electroencephalograph (EEG) technology to examine cerebral activity during sleep onset. Waveforms recorded by EEG are broadly classified as delta (below 4Hz) associated with sleep, theta (between 4 Hz and 8 Hz) associated with drowsiness, day dreaming, and hypnosis and alpha (between 8 Hz and 12 Hz) associated with a relaxed waking state. Hori has divided hypnagogia into 9 stages of brain activity, in which there is a gradual transition from alpha to theta in brain activity. [15] It is important to consider the significance of closed or open eyes. The production of theta activity with eyes closed is associated with deep relaxation but with eyes open could indicate inattention and fatigue and has been associated with ADHD. Attempts to use biofeedback to volitionally initiate and control a hypnagogic state, in order to enhance creativity, date back to the work of Green and Green in 1977. [16] More recently work has been carried out to explore the use of alpha/theta neurofeedback in a therapeutic context and some reported success has been achieved with alcoholism and post-traumatic stress disorder. [17][18] Other studies have used the alpha/theta wave neurofeedback training protocol to improve the performance of music and dance. One such study reported wide ranging positive outcomes, which extended beyond the metrics used to judge the quality of the creative outputs, into the realms of commitment, confidence, deportment, stage presence etc. [19] Despite the positive outcome that Gruzelier reports he also identifies a number of unresolved issues which this intervention raises.

"Numerous questions about implementing the A/T protocol remain including: the need for maintaining a borderline state of consciousness between waking and sleeping, the need for alpha–theta crossover, the importance of alpha training independent of slower wave training, the need for dissociation between theta and delta and indeed the role of sleep, as well as the involvement of the hynogogic experience itself which provided the inspiration for the EEG training protocol." [20]

## 6. Proposed Method

In this study our intention is to investigate the potential of using EEG data in conjunction with hypnotic techniques to create personalised audio material designed to be played back via an in-ear monitoring system during an improvised performance. Three participants (already enlisted) will be invited over a period of one month, to attend three preparatory sessions and undertake a performance in front of an invited audience. The participants have a background in freely improvised and experimental music. They have been fully informed about the nature of the study and the techniques being used and have given full consent. No issues relating to performance anxiety or apprehension about the psychological techniques being used have been identified. The three preparatory sessions will take place weekly before the

performance and will comprise a 30 – 45 minute hypnotic induction. The first sessions will include assessing the participants on the SHSS-C scale of hypnotic suggestibility. During each session the participant's brain activity will be monitored on screen via a map of delta, theta, alpha and beta waves. The EEG equipment in use will be a low-cost commercially available 14 channel system with EPOC Brain Activity Map software. By monitoring the EEG activity the hypnotherapist will endeavour to induce and maintain a hypnagogic state at the point of alpha–theta crossover. Once this condition has been achieved a variety of post-hypnotic suggestions will be delivered to create an association with the subjective feeling of this cognitive state. During sessions two and three these suggestions will be tested and reinforced. It is anticipated that all sessions will take place on the same week day, at the same time and in the same location, including the performance. The preparitory sessions will essentially provide a form of neurofeedback, which is mediated through the hypnotic induction. The triggers for the post-hypnotic suggestion will be verbal cues, which will be embedded into the audio 'score' which the performer will listen to during performance. The rationale for the development of the audio score using spoken material has a relevance to the issue of cognitive load and reflex response discussed earlier, and will be explicated further in a subsidiary paper.

In the majority of cases, the creative output from research in this area is not evaluated from the perspective of the musician. Normally results are generated from quantitative data produced under experimental conditions or qualitative evaluation of the creative output by an expert audience. The methodology we have constructed is designed to capture the experience of the performer both during the preparatory sessions and the performance. The preparatory sessions will be recorded to document each performer's EEG response to the hypnotic induction, after which a short interview will be filmed and questionnaire completed, which will be used to evaluate their subjective experience. After the performance in the fourth week a final interview will be filmed and questionnaire undertaken. The participants will be contacted one month after the performance by email and asked to reflect anecdotally on their experience in free writing.

## 7. SUMMARY

This project has been inspired by the anecdotal evidence expressed by improvising musicians of high professional standing, of an internal conflict or dilemma which arises from a desire to produce fresh and original musical material when they improvise. The roots of this dilemma can be traced to biological systems which have evolved to limit the performance of those behaviours under conscious control, compared with other subcousious systems which make up our physiology. In the context of creative expression Gruzelier asserts that "artistic performance requires the integration and expression of past learning and expertise, the imbuing of this in performance, and the communicating of this artistry to the audience. Theta is an ideal candidate for this wide ranging integrational role. [21] This paper proposes an approach to the improviser's dilemma by evoking a theta brain state and through the use of hypnosis, harnessing the creative potential of hypnagogia in live improvised performance. The experimental work proposed here is due to be undertaken in the coming months and the results published accordingly.

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