Hypnagogia and Improvisation: Interfacing With Reflexive/Volitional Behaviour.

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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 the notion of interface from the perspective of deep interaction, interaction which is initiated at the threshold of conscious awareness and volitional control. The context for this work is improvised musical performance and this paper describes an experimental methodology which will be employed to explore procedural memory and readiness potential by using a combination of EEG and hypnosis, as a means of interfacing with the reflexive/volitional behaviour of an improvising musician. This paper describes the motivation for this work as seated in the anecdotal experience of many professional improvisers and puts forward a theoretical rationale for this particular approach to addressing their concerns. The issues they identify reflect a desire to enhance the sense of 'liveness' in their performance by circumventing mechanical modes of playing.

Keywords: Improvisation, Hypnagogia, Biofeedback, Reflex, Volition.

1. Introduction.

The term programming is used ubiquitously when applied to inanimate technological devices, it is rarely applied to humans and when it is, the implication is that the effect is dehumanising. To describe a human as having been in some way programmed to behave in a certain way, implies their own sense of agency has been subverted. Much of our behaviour is, of course, programmed genetically and culturally and to a certain extent we programme ourselves, by undertaking activities designed to leave a repository of encoded behaviour. Musicians spend many hours encoding motor skills in order to give access to a wide range of functionality on 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, "Habit diminishes the conscious attention with which our acts are performed" (James 2007, 115). An important area in the brain 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 additional inputs from other parts of the brain, the basal ganglia controls voluntary motor movement, procedural learning and routine behaviours or 'habits'. Once motor skills have been acquired and stored in procedural memory 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.

Unlike inanimate devices, humans can access their programmed functionality consciously or unconsciously. In the late 17th century the nature of reflexive behaviour was explored by Willis and Descartes when they put forward their dualistic interpretation of cerebral activity as controlling either the mechanistic aspects of human behaviour or the volitional. 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. Hall's hypothesis essentially maintained a dualistic approach which is now rather redundant. The binary distinction has been replaced by a sliding scale , "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" (Prochazka et al. 2000).

2. Improvising within cognitive limits.

In 1998 Jonathan Wolpaw asked, "are the words reflex and voluntary useful scientific concepts or are they prescientific terms that should be discarded?" (Prochazka et al. 2000). 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. 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 rises and falls. 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" (Pressing 1988, 129-178). For the majority of improvisers this is of no concern but there are many accounts of musicians expressing frustration when the interface between their intent and their actions is restricted by cognitive limitations. 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" (Hamilton 2007, 102).

In 1965 Kornhuber and Deecke discovered 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 in a self initiated act. Libet discovered that on average readiness potential started 0.55 seconds before the act, while the subject becomes conscious 0.2 seconds before the act. Libet concluded that "cerebral initiation even of a spontaneous voluntary act ... usually does begin unconsciously" (Libet 1985). 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. This revelation adds further distance between the act of improvisation and the improviser's sense of agency.

Contrasting 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 which are emancipating. Derek Bailey relays a different experience of improvisation, which embraces disorientation and distraction as a means of developing methods of provoking novel musical behaviour, not limited by conscious intent.

> 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. (Bailey 1992)

5. The Human API.

Many musicians suffer from stage fright and other anxiety related issues. These afflictions are, for the most part, driven by an inappropriate subconscious response to a situation, initiated by areas of the brain controlling instinctive behaviours such as the anterior cingulate cortex and the amygdala. Hypnotherapy is effective in reducing anxiety in a performer by substituting a defective behavioural template for an effective one and may also provide a tool for improvisers to explore the reflex/volitional dilemma. In therapeutic contexts the presenting symptomology 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 and has long been association with creativity. 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, CG Jung, Jean Paul Sartre, Salvador Dali, Ludwig Van Beethoven, Richard Wagner, Salvador Dalí and Isaac Newton have all reported this psychological phenomena to have had a profound and positive effect on their creativity.

> 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 (Nachmanovitch 1990, 14)

Electroencephalograph (EEG) technology has been used to examine cerebral activity during sleep onset in several studies. To understand the features of hypnagogia, this transitional phase has been divided into 9 stages of brain activity, in which the alpha and theta brain waves crossover (Hori 1994, 237-253). In 1977 Green and Green attempted to use biofeedback to volitionally initiate and control a hypnagogic state, in order to enhance creativity (Green 1977). More recent studies have used the alpha/theta neurofeedback training protocol to improve the performance of musicians and dancers, objectively verified by an expert audience (Gruzelier 2009).

6. Proposed Method.

In improvised musical performance when the creative act is conceived and delivered in real-time the potential for intervention is limited. Our intention in this project is to investigate the use of EEG in conjunction with hypnotic techniques, to create audio material designed to be played back via an in-ear monitoring system during a performance, rather like a sonic 'score'. Three musicians have been invited 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 and 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. Each participant will be assessed 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 using the 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 preparatory session 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 sonic 'score' which the performer will listen to during performance. The rationale for the development of the sonic 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. 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.

Inspired for this project has been the anecdotal evidence of improvising musicians of high professional standing, expressed 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 behaviours under conscious control, compared with more efficient subconscious initiation of behaviour. 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" (Gruzelier 2009). Through filmed documentation and structured interviews this project will endeavour to capture the performer's subjective experience of undertaking the project and their perception of the resulting performance. This projects attempt to evoke a theta brain state through the use of EEG and hypnosis, as a means of 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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