The restructuring of temporality during art making

Experienced time, neural time and clock time are not the same. Temporality may be restructured due to psychopathologic experiences resulting in the perception that time may speed up or slow down, before the living present has been appropriated by reflection. There is growing evidence that the awareness of linear time has the ability to become distorted when, during art making, artists experience the brain state referred to as flow, during which psychic energy is focused on the unfolding present, with a general absence of rumination associated with past or future events. From a neuroscientific point of reference flow necessitates a state of transient (short of duration) hypo- (unusually low) frontality (anterior part of each cerebral hemisphere, in front of the central sulcus). Flow has been associated with a (form of) altered state of consciousness, which may share, amongst others, characteristics such as time distortions, attention, perception, imagery and fantasy. Through the use of electroencephalography and interviews, this paper links selected artists' restructuring of temporality with concepts of human consciousness and time perception
Key words: art making, flow, restructuring temporality, transient hypofrontality, time perception.

Die herstrukturering van tyd gedurende kunsskepping
Ervaringstyd, neurale tyd en horlosietyd verskil. Dit gebeur dat tydservaring as gevolg van psigopatalogiese ervarings hergestruktureer word, wat tot die persepsie kan lei dat tyd versnel of vertraag, alvorens die hede deur nabetragting toegeëien word. Daar is toenemende bewys voor dat die besef van liniêre tyd tydens kunsskepping verwring word wanneer kunstenaars die breintoestand bekend as vloei ervaar. Daartydens fokus psigiese energie op die ontplooiing van die hede sonder die moontlikheid om oor die verlede of die toekoms na te dink. Uit 'n neurowetenskaplike oogpunt vereis vloei 'n toestand van verbygaande hipofrontaliteit. Vloei word geassosieer met 'n vorm van veranderde bewussyntoestand wat aan belewenisse van tydswysigings, aandag, persepsie, verbeelding en fantasie verwant is. Deur die gebruik van elektroënkefalografie en onderhoude bring hierdie artikel gekose kunstenaars se hergestruktureerde tydsverloop met konsepte van menslike bewustheid sowel as tydspersepsie in verband.
Sleutelwoorde: kunsskepping, hergestruktureerde tydsverloop, verbygaande hipofrontaliteit, tydspersepsie

Clock time (or objective time), neural time and experienced (or psychological) time are not the same. Events occurring in the external world (clock time) and neural time (neurons firing) can be measured. However, experienced time, or perceived time can only be established by personal reports. This article will proceed with a discussion on philosophical, followed by psychological concepts, of time. A discussion of neural time will follow as an introduction to consciousness and altered states thereof, with the focus on the brain state referred to as flow. A select population of artists' experience of time whilst engaged in the art-making process will illustrate the concept of restructured temporality.

In the past philosophers such as Martin Heidegger and Immanuel Kant, and psychologists such as William James and Robert Ornstein debated time perception variously. Farther back in Western history, for St. Augustine (ca. 354-430) the experience of time depended on sensory experience and the memory of sensory experience – for him humans experience only the present (Hergenhahn 2009: 81). Kant suggested in the eighteenth century that the experience of concepts such as unity, totality, causality, and reality do not come from experience, but rather exist as *a priori* categories of thought which structure sensory impressions. Phenomenological experience, thus, is a result of the interaction between sensations and the categories of thought. Kant emphasises that everything that humans experience or perceive of the outer world is *a priori* structured in time and space. Kant postulated that an individual's actual cognition of objects has to involve something that cannot be conceptual. "This

"something" is best understood as an embodied viewpoint; a perspectival point of spatial and temporal orientation….Kant would call this nonconceptual element of cognition intuition" (Van Mazijk 2016: 3). Thus, for a knowledgeable experience, both sensation and *a priori* concepts are necessary. This illustrates what van Mazijl (2016) describes as Kant's transcendental philosophy being most famous for – for synthesising empiricist and rationalist trends of thinking.

Kant's "intuitions" must take place through the pure form of time (van Mazijl 2016: 5). Time, according to Kant, has three modes – duration (in which the continuity of time needs to have a counterpart in the world of experience), succession (again, if there are necessary connections in the experienced world one can say that one event precedes another) and coexistence (in which events are tightly linked together in the experienced world which endure through all time) (Walsch 1967: 379-85). Even though Kant remarks that time itself remains and does not change, time itself cannot be perceived. Kant, Husserl and Heidegger profess that time is the condition of possibility for having perceptions of the world – connections are made between contents of experience that stretch over time. It is through temporal synthesis that the contents of consciousness are unified by living in the past and the future concurrently. Temporality, in this sense, is content where "the now" is interconnected with the past and future. Husserl suggests that any field of sensations has an affective structure – sensations are prestructured through temporal synthesis into affective fields prior to an individual directing attention at them (Van Mazijl 2016: 8-9). Such affective fields contain a *sui generis* structure and affective meaning in which a particularly strong affective allure may elicit an intentional act of perception. This may come about if the ego is sufficiently alerted toward the source of affection to engage in a perceptual act.[i]

Van Manen (2007: 16) concurs with Edmund Husserl's notion of 'primal impressions' as a form of consciousness that presents itself as time – "time as we live through it – as the living present before it has been appropriated by reflection… [L]ived experience is simply experience-as-we-live-through-it in our actions, relations and situations". Van Manen (2007:21) continues that one experiences an implicit, felt understanding of the self in situations even though it is difficult sometimes to put that understanding into words. One such situation could be our experience of time speeding up or slowing down.

Wilhelm Wundt (1832-1920), through experiments to determine relative timings of visual and auditory stimuli, found many examples of what became known as "subjective time displacement" in which people erred about the sequence of events (Blackmore 2004: 61). Benjamin Libet (1916-2007) is best known for concluding that consciousness and neural activity are the same thing. Through electroencephalographic (EEG) experiments in which the sensory cortex of conscious, awake, participants was directly stimulated through the application of electrodes, Libet concluded that about half a second of continuous neuronal activity is required for consciousness (also referred to as neuronal adequacy). Libet suggested that since subjective referral with regard to space had been accepted, subjective referral in time should follow (Blackmore 2004: 57-60). Francisco Varela (1946-2001) was of the opinion that the findings of a disciplined first-person approach should be an integral part of neurobiological proposals, particularly in the exploration of temporality.

Time, undeniably, is a dimension of the physical universe.[ii] How humans experience it is subjective. William James (1842 – 1910) formalised the commonplace observation that time passes quickly when individuals are busy, whereas the converse is observed during "idle time" (James 1890). Buetow (2004: 3) cites Heidegger, who refers to the sense of duration as being

idiosyncratic and varied in the sense that each same or similar situation may result in different experiences of time. Levine (2009) suggests that the conflicts that arise between time and timelessness are interrelated with one's experience of Freud's reality principle (the ego's ability to postpone gratification to avoid unpleasant consequences) and the pleasure principle (instinctive behaviour, gratification of immediate needs and avoiding pain). These principles, in turn, relate to one's capacity to shoulder the losses and disappointments experienced, and the opportunities and possibilities that life may hold. Levine (2009: 334) refers to Freud's notion that transience value is scarcity value in time – "Limitation in the possibility of an enjoyment raises the value of the enjoyment". When the neurosurgeon Paul Kalanithi (2016: 197).was facing death as a result of terminal cancer, he said that time felt less like the ticking clock and more like a state of being – the time of day started to mean nothing.

How an individual (for purposes of this article an artist) perceives time is context-dependent, personal and highly subjective. For the artist, the ability to translate events through the medium of art into a temporal sequence is linked to a sense of reality and the perception of time. Buetow (2004: 22) opines that in terms of the experience of the duration of time (or "lived time") people may manipulate temporal experience for reasons of creativity or self-actualisation. Levine (2009: 336) cites Reed who suggests that such fundamental ego functions "are dependent on and associated with the capacity for psychic representation, which in turn is central for symbolic function and the creation and preservation of meaning".

The perception of time as timelessness may have both negative or positive connotations, however, it is the ego which engages in the processing and reorganising of time. For the artist it is the ability to respond to immediate stimuli and circumstances, reconciling internal and external experiences and constructing visual narratives and expressions from such sources, retrieving and reconstructing memories and making sense out of seemingly random associations. Levine (2009: 336) states: "This is the view of the ego as possessing a vital and continuing function of unconsciously transforming, naming, signifying, resignifying, organizing, and reorganizing via recall and association…". Should restorative actions following trauma to an individual not be engaged, experiences and events may remain frozen in time, excluded from time, excluded from one's personal history. It is the context in which memories relate to the past that adds meaning to one's life – but this occurs within new, current circumstances and lived experience in the present. Thus memory is rearranged and is present repeatedly, representing changed phases of one's life, which may explain why artists tend to create art around one or more central themes repeatedly.[iii] This is possibly where phenomenology, with regard to a systematic study of human consciousness with regard to experienced time, overlaps with psychology.[iv]

Experienced time and neural time

"Subjective or psychological time is the internal experience of how fast time is passing, or how much time has passed since the occurrence of some event" (Meck 2004: 1). Buetow (2004: 21-24) refers to time prolongation when time is experienced as having passed slowly; time compression is when it passes quickly, or it can be in rough synchronisation with clock time. The experience of time duration has been theorised to be associated with information processing. When individuals are conscious of themselves and the situation in which they find themselves, perceived time duration is thought to be highest, through time passing slowly. "This high level of consciousness is associated with a high density of experience, meaning a high level of information processing" (Buetow 2004: 23). In turn, perceived time duration is

shortest, with time appearing to pass quickly, when the individual's consciousness of the situation and concern for the self is low. Thus, when there is little need for cognitive involvement or emotional engagement, information processing is low. Studies done by Flaherty and Meer (1994) concluded that time quickens under conditions of habitual activity, where low problem-solving is required and when individuals act as if engaged in 'automatic processing'. This concept would be reframed by neuroscientists in the 21st century as *transient hypofrontality* – see below.

One's ability to discern clock time or objective time tends to be a reliable function, except in the case of severe psychiatric disorders (such as poorer time discrimination reported among schizophrenics), brain pathology, changes due to normal aging or where pharmacological or toxicological intervention is present. Banich (2004: 14) concurs with Ivry (1997) that the cerebellum is deemed critical for timing information, acting as the brain's "internal clock". The use of an individual's internal clock, in order to measure objective time, relies on a realistic estimation of subjective time without the benefit of prompts from external clocks. An important consideration is that because of the difficulty in localising this internal clock within the brain, "…the discipline of timing and time perception has struggled to define its own identity and to separate itself from the study of other cognitive processes such as attention and memory" (Meck 2004: 1). Ivry and Spencer (2004) concur: "The representation of temporal information remains one of the most elusive concepts of neurobiology. Unlike vision and audition, there are no dedicated sensors for time. Yet the passage of time is as perceptually salient as the color of an apple or the timbre of a tuba".

There appears to be a need for research that is directed towards identifying a distinction among clock speed, attention and memory accounts vis-à-vis changes in timing behaviour. Meck (2004: 2) offers that humans and other animals have a successfully adapted time sense in the seconds-to-minutes range. This is essential, evolutionarily, for assessing one's environment in terms of predators or prey. Humans, in particular, are excellent at interval timing and sequencing and are able to make temporal discriminations – this is apparent in understanding musical structure where small perturbations in rhythm are important, for motor control (in millisecond time estimations), for language processing, updating working memory and for making predictions about one's environment. This points to the existence of a specialised timing system.

Ivry and Spencer (2004: 225-29) refer to brain lesion studies that indicate that the cerebellar cortex provides an accurate representation of the temporal relationship between consecutive events and in addition, that the basal ganglia is involved in temporal processing.[v] The same authors note that dopaminergic agents lead to a distortion of timed responses. Thus, dopamine (a common neurotransmitter) levels may distort the perception of time – agonists (for the treatment of low dopamine conditions such as Parkinson's disease or attention deficit disorder) and antagonists (for blocking dopamine receptors for treating schizophrenia or bipolar disorder) can lead to a shortening and lengthening of perceived time.

Brain research has defined an area of the frontal lobes, referred to as the medial prefrontal cortex (mPFC) as the brain area that facilitates a person's ability to step out of the here and now and experience temporality. Dietrich (2007c: 204) refers to the mental flexibility provided by the prefrontal cortex which liberates one from being stuck in the here and now. When the prefrontal cortex is not fully mature, is damaged, or its capacity is diminished due to a variety of reasons, an inability arises in terms of placing the past, but especially the future, in context – this is what Restak (1988: 135) referred to as "temporal discounting". An example of

temporal discounting, where an individual lives *for* the moment (rather than *in* the moment as in Buddhist tradition) is impulse-driven behaviour which could result in, for example, compulsive gambling.[vi]

Time distortions in phenomenal consciousness are a result of mental disorders that involve dysfunction of the prefrontal cortex. Examples are depression, schizophrenia or Alzheimer's disease. Some altered states of consciousness (discussed below) are distinguished by a sense of timelessness, in which the individual is unable to extract him/herself from the restrictions of the present, or is unable to consider time as a variable. Such states could be drug-induced, brought about through hypnosis, dreaming, or meditation (Dietrich 2007c: 204) and often carry a negative connotation. As mentioned, a fully-functional person generally has the ability to step out of the here and now.[vii] Yet, in some cases stepping in and out of the here and now could be referred to as an altered state of consciousness from which the individual experiences short- and long-term benefits. Examples are "runner's high" or the brain state referred to as *flow*. Before discussing altered states of consciousness, it is necessary to understand consciousness.

Consciousness

There are various, and differing, definitions of consciousness, some of which will be discussed here. About which there seems to be general consensus is that consciousness correlates to some extent with the degree of complexity of the nervous system. There also seems to be agreement that there are many forms of consciousness, such as those related to seeing, thinking or emotional pain (Crick and Koch 1998: 97).[viii] Damasio (1998: 1880) defines human consciousness as, amongst others, that which permits "awareness of self and surroundings".[ix] Being "conscious" is also used as the equivalent of knowing something, or attending to something (Blackmore 2004: 2). Consciousness is also often contrasted with "unconscious", and is taken as more or less equivalent to "responsive" or "awake".

In this article consciousness is regarded as an equivalent of "personal experience" or "subjectivity" – in this regard Blackmore (2004: 9) emphasises that consciousness is a private experience. Crick and Koch (2004: 1133) also emphasise that consciousness is idiosyncratic/private:

> We have previously discussed why we think consciousness has to be largely private. By private we mean that it is impossible for me to convey to you the exact nature of my conscious percepts, such as seeing red, although I can convey whether two shades of red appear to me to be the same or different.

Human consciousness has been described as being hierarchically ordered, of which the key instrumental resources (of cognition) are perception, movement, memory, language, and reasoning (Damasio 2007c: 3). The cerebral cortex, and in particular the prefrontal cortex, is at the top of that hierarchy, representing the neural basis of higher cognitive functions (Dietrich 2003; Fuster 2000).[x] Dietrich (2004a: 747) explains how cognitive function came to be hierarchically ordered:

> Evolutionary pressures forced the development of ever more integrative neural structures able to process increasingly complex information. This in turn led to increased behavioral flexibility and adaptability. The cerebral cortex, and in particular the prefrontal cortex, is at the top of the hierarchy, representing the neural basis of higher cognitive functions.

In addition to this hierarchical order that developed, Gilbert (2001) suggests that it was the evolution of cortical layers that allowed two motor systems (automatic and conscious) – and

consciousness – to come into being. Neural correlates of consciousness similarly emphasise frontal cortex functions for higher attributes in the most recent theories surrounding consciousness (Dietrich 2003). Crick and Koch (1998), Markowitsch (1995), Dehaene and Naccache (2001), further substantiate frontal cortex function regarding consciousness.[xi]

The central nervous system is capable of processing a certain amount of information at any given time. Csikszentmihalyi (2002: 28-33) refers to around seven bits of information – such as sounds, visual stimuli, recognisable nuances of emotion or thought, that the shortest time it takes to differentiate between such bits is about 1/18 of a second and that it is attention that determines what will or will not appear in consciousness.

It is prudent to list the mental functioning typical of consciousness, even though it is important to remember that what may be deemed 'normal' is a subjective definition. Blackmore (2004: 324-35) offers:

1 Attention
2 Perception
3 Imagery and fantasy
4 Inner speech
5 Memory
6 Higher-level thought processes
7 Meaning and significance
8 Time perception
9 Emotional feeling and expression
10 Arousal
11 Self-control
12 Suggestibility
13 Body image, and
14 Sense of personal identity.

It follows that different altered states of consciousness (such as drug-induction, central nervous system depressants, narcotics, anaesthetics, antipsychotics and antidepressants) may include a change in any of the listed functions, but what altered states of consciousness share are characteristics such as time distortions, disinhibition from social constraints, or a change of focused attention, and are considered to be transient in nature. Commensurately, for example, some altered states of consciousness may create more focused attention where time can seem to speed up, slow down, or change completely; physiological arousal (including the reduction of physical metabolic rate) may occur; or the sense of identity may be altered.

Altered states of consciousness

Dietrich (2003) refers to the hallmark of altered states of consciousness as the subtle modification of cognitive functions that are typically ascribed to the higher cortical layers – the dorsolateral, ventromedial, temporal, occipital and parietal cortex. Dietrich further hypothesises that the mental states commonly referred to as altered states of consciousness are primarily due to transient prefrontal cortex deregulation. He proposes that transient hypofrontality is the unifying feature of all altered states and that the phenomenological uniqueness of each state is the result of the differential viability of various frontal circuits. Such states could include "induction methods" such as dreaming, endurance running, meditation, daydreaming, hypnosis, various drug-induced states (Dietrich 2003:237-49) and the flow brain state (Dietrich 2004a). The uniqueness of each altered state is dependent on how specific

prefrontal circuits are targeted by induction methods, which remove "their computation from the conscious experience" (Dietrich 2003: 249). Dietrich (2007c: 278) adds that each altered state of consciousness is phenomenologically unique in that each induction method (or technique) likely targets a different set of prefrontal circuits, resulting in a distinct pattern of phenomenological subtractions. How the flow brain state shares characteristics with altered states of consciousness is discussed in the following section.

The brain state of flow as transient hypofrontality

Flow, also associated with peak performance, is a psychological state characterised by nine specific phenomenological dimensions, some of which are prerequisites, and some related to subjective experiences (Bond 2006; Csikszentmihalyi 1978; 1982a; 1982b; 1985; 1990; 2002; 2004). Typical prerequisites include balance of challenge and skill, clear perceived goals, unambiguous feedback, and total concentration on the task at hand. Subjective experiences include the following: sense of control; merging of action and awareness; loss of consciousness of self; speeding up or slowing down of time; and a sense that one is engaged in an autotelic (self-directed, intrinsic and rewarding) experience (Van Heerden 2010: 144).

Csikszentmihalyi (1997a: 6) refers to the sense of time having the ability to become distorted when experiencing flow. When engaged in flow, attention is directed away from conscious concern for the self and rather directed at the task at hand. Lee (2005: 9) refers to a person in flow not being concerned with how others may perceive him/her – when flow is absent some people tend to procrastinate as an avoidance technique to protect their self-esteem and others' scrutiny. Csikszentmihalyi (1990: 49) refers to the enjoyment of being engaged in the task at hand leading to flow and that "concern for the self disappears, yet paradoxically the sense of self emerges stronger after the flow experience is over."

During flow, psychic energy is focused on the unfolding present, with a general absence of rumination associated with past or future events – "[t]here is no room in your awareness for conflicts or contradictions..." (Csikszentmihalyi 1997b: 1). In addition, temporal measures are overruled by the engagement in, and the concentration of, the task at hand. Kalanithi (2016: 104-5) describing the intense concentration required to perform neuro surgery, observed that whether he raced frenetically or proceeded steadily, he had no sense of time passing – "If boredom is, as Heidegger argued, the awareness of time passing, then surgery felt like the opposite: the intense focus made the arms of the clock seem arbitrarily placed. Two hours could feel like a minute. Once the final stitch was placed and the wound was dressed, normal time suddenly restarted." Brown and Ryan (2003) suggest that flow activities are characterised by engagement with and attention to 'what is occurring'. They compare flow with being attentive to and aware of what is taking place in the present with the notion of 'mindfulness'. Knight (2004) avers that when in flow an awareness of linear time and the accompanying sense of the possibility of failure are overwhelmed.

Dietrich (2003; 2004a; 2004b; 2006; 2007a; 2007b; 2007c) has emerged as the seminal researcher on the neurocognitive mechanisms underlying creativity and the experience of flow. His primary hypothesis is that a necessary prerequisite to experience flow is a state of transient hypofrontality that enables the temporary suppression of the analytical and meta-conscious capacities of the explicit system; as such, flow and creativity recruit different brain circuits. Flow necessitates a state of transient (short of duration) hypo- (unusually low) frontality (anterior part of each cerebral hemisphere, in front of the central sulcus) that empowers the implicit system to execute a task at maximum skill level with maximum efficiency. Here

information is computed in a skill-based manner. This action enables the temporary suppression of the analytical and meta-conscious capacities of the explicit system. Creativity, on the other hand, is enabled by the cognitive capabilities provided primarily by the dorsolateral prefrontal cortex (DLPFC), which is involved in executive function. Thus, decreased activity in the DLPFC may indicate a reduction in working memory demands. Limb and Braun (2008: 8) note that deactivation of the lateral prefrontal regions represents the primary physiological change responsible for altered states of consciousness such as hypnosis, meditation and even daydreaming – according to them, many types of creative activity seemingly take place in an analogously altered state of mind.

The restructuring of temporality during art making

In a previous article on a mixed-methods study Van Heerden and Munro (2014: 139) refer to a fundamental question in the study of consciousness as being the connection between subjective report and objective measures thereof. Similarly, if art making or flow are considered to be in the domain of consciousness (or altered consciousness), the fundamental question in the study of art making or flow is the subjective experience and objective measures thereof.

This article incorporates a mixed methods approach about art making and flow. Both quantitative (EEG) and qualitative (interviews) descriptive components were engaged, where objective (quantitative) measures were paired with the artist's subjective experiences of the same art making events. It is important to note that observing, or imagining art will not yield the same data as that which relates to *making* art. To the author's knowledge, to date the correlation between participants' perceived propensity to experience flow and participants' performance during art making have not been measured and reported on satisfactorily in a scholarly or scientific way.[xii]

A purposive sampling method was employed, with consideration of the parameters of the population. In order to narrow the potential for variability, the sampling was homogenised as far as possible, inclusive of restricting it to a specific gender. As multimodal, detailed, in-depth data were collected from participants, five healthy (no history of prior neurological or psychiatric diseases), right-handed male artists, mean age 61 years, with no less than 35 years of professional art making experience, were considered appropriate to meet the full complement of participants. In the following section electroencephalography is discussed, the findings of which illustrate hypofrontality with artists who participated in the study. Hypofrontality, as has been explained earlier, indicates a strong propensity for experiencing an altered state of consciousness. Recall that time distortions are a hallmark of altered states of consciousness.

Electroencephalography

Van Heerden and Munro (2014: 144) reported in a previous article that the use of EEG data collection affords an overview of brain wave activity. This is achieved by observing idiosyncratic brain wave activity of the artist in delta (1-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), SMR (13-15 Hz) , beta (16-34 Hz) and gamma (35-42 Hz) brain wave ranges during five recording segments, over three recording sessions. A comparison of left/right, as well as frontal/parietal brain wave activity is facilitated by placement of recording electrodes at C3, C4, Fz and Pz recording sites – such receptor sites are indicated in Figure 1, which represents the standard placement of electrodes during EEG recording.[xiii]

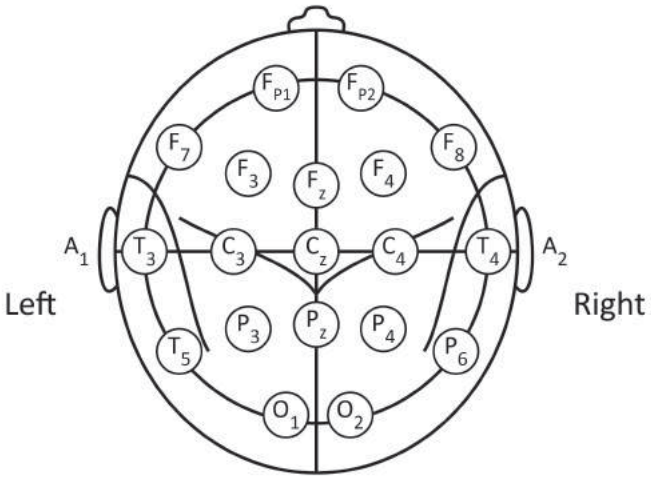

Figure 1
Standard placement of electrodes during EEG recording – also known as the International 10-20 System (source: Van Heerden and Munro 2014: 142, adapted from Banich 2004: 87).

Idiosyncratic data for each artist over three recording sessions were pared down to averages and then all five artists' results were compared with each other. Five consecutive recording segments for each recording session were required, allowing for demarcations of brain wave activity during eyes closed with no action (three minutes); eyes open with no action (three minutes); eyes open with 20 minutes of art making; eyes closed with no action (three minutes), followed by eyes closed with no action (again three minutes). In this manner data gathered during the art-making recording segment is unambiguous when compared with other recording segments.

Van Heerden and Munro (2014: 145-6) expand on the method used: An EEG amplifier captures the raw EEG data expressed in microvolts (μV) which is then transcribed algorithmically as numerical 'means'. The transcribed numerical data is transferred to MS Excel© and represented in the form of spreadsheets, bar and line graphs. Thus, patterns are provided by spectrographic readings of the mean peaks and troughs of the brain wave activity at particular receptor sites, representing the duration of a particular segment, over the three recording sessions. Following the initial detailed brain wave patterns, means (or averages) of the three sessions of each artist, in each concurrently recorded brain wave phase (delta, theta, alpha, and so forth) are calculated to facilitate further comparisons. Patterns and emerging themes or trends are identified and compared with data obtained from the interviews of the artists whilst making art.

Encephalographic findings

All five artists recorded higher brain wave activity at the parietal lobe receptor site (Pz) versus the frontal (Fz) during art making. This strongly suggests transient hypofrontality, a hallmark of being in the state of flow and/or an indicator of an altered state of consciousness. Equal left/right cerebral hemisphere brain wave activity was recorded at C3 and C4 receptor sites during art making. This finding concurs with studies conducted by Liu and Miller (2008), Belkofer and Kanopka (2008) and others, indicating that art making is not the preserve of any particular hemisphere.

All five artists recorded an increase in alpha brain phase activity during the art-making recording segment. An increase in alpha wave activity could indicate internal orientation, or some types of meditation (Thompson and Thompson 2003: 10). Internal orientation is associated with a sense that one is engaged in an autotelic experience – a universal condition of flow. One could also conclude that art making could be likened with a form of meditation. Alpha wave phase occurs during wakefulness and is observed when in a relaxed state (Srinivasan 2007: 113). Alpha indicates sensory input and illustrates the content through imagery and sensualisation; it links the conscious mind to the subconscious (Wise 2002: 140). Alpha further denotes meditation or relaxation, lack of cognitive processing, contemplation, visualisation, problem-solving and/or deeper creativity (Stinson and Arthur 2013: 4). It could be true of all five artists that the increase in alpha brain wave activity is due to visualisation, as all five paint and draw images that reflect a transcended reality (none are artists that mimic reality as such).

Increased alpha power in anterior cerebral regions reflects hypofrontality; "the frontal brain must be downregulated to produce creative ideas" (Fink and Neubauer 2006). The increased alpha activity could thus indicate an association with flow, a function of hypofrontality. Alpha brain waves are generally found in relaxed yet alert mental states or shifts of consciousness (Belkofer and Konopka 2008: 57). In addition, it denotes a state of meditation and a sense of inner calm or peacefulness (Demos 2005:115). Individual artists used descriptors of the art making experience as being trancelike and addictive – this could denote hypofrontality manifesting as a (form of) altered state of consciousness.

Alpha synchronisation is viewed as a cortical 'idling' phenomenon; also an active inhibition of task-irrelevant brain regions – preventing internal information processing to be disturbed by external input or conflicting operations (Fink *et al*. 2009). This could point to total concentration on the task at hand – a prerequisite for the flow state. Alpha synchronisation during creative thinking could reflect a state of enhanced concentration or alertness of involved brain circuits. In parieto-occipital brain regions alpha synchronisation could serve as a mechanism responsible for active inhibition or suppression of distracting and interfering information flow from the visual system; where cortical processes are driven by free floating associations or mental imagery (Fink, Graif and Neubauer 2009: 860-1). Enhanced alpha activity is found during insightful problem solving (Fink *et al*. 2009: 744-5). One could conclude that making art, even though it may create the perception of being effortless, could be demanding.

All five artists recorded increased gamma wave activity during the active recording segment. Gamma denotes cognitive activity, attention, 'binding rhythm', and is seen at the moment of correcting balance (Thompson and Thompson 2003:10). The author contends that the prerequisite element of flow that refers to unambiguous and immediate feedback when an artist "knows" what mark to put on the canvas or paper concurs with the previous descriptors.

Gamma oscillations are modulated by a variety of cognitive processes such as attention, object recognition, and working memory. Gamma activity is assumed to reflect an integration mechanism of the brain (Herrmann and Demiralp 2005: 2722). Synchrony in gamma activity binds elementary visual attributes into a coherent ensemble. The gamma range is associated with different stages of perception and learning (Antal *et al*. 2004: 1307). It plays an integral role in information processing (De Pascalis, Cacace and Massicolle 2004: 27). Synchronomy occurs during problem solving. Gamma activity is associated with 'organising' the brain, promotes learning, and allows for mental sharpness. It is de-activated when no specialised task

is at hand (Demos 2005: 120). Artists' description of 'pushing the boundaries' whilst making art may be associated with such descriptors.

Increased gamma activity has been observed during dreaming and hallucinations (Croft *et al.* 2002; Herrmann and Demiralp, 2005: 2719). It is enhanced when people subjectively distinguish a pattern from a seemingly random array of visual stimuli (Croft *et al.* 2002). Increased clarified amplitudes of gamma are associated with feelings of satisfaction, gratitude, compassion and love (Rubik 2011: 110). High gamma activity could also denote feelings of peacefulness (Vialatte *et al*. 2009). As with an increase in alpha brain wave activity, individual artists used descriptors of the art making experience as being satisfying, trancelike and addicitive – this could denote hypofrontality manifesting as a form of altered state of consciousness. Gamma performs a unique role as the "event binding rhythm" – binding together neural representations of simultaneous events in a unified whole. In the visual system, high frequency (40-60Hz) oscillations are believed to be facilitated during information processing that underlies perceptual analysis, object recognition and learning (Antal *et al*. 2004).

Semi-structured interviews

Semi-structured interviews allow for scope and depth, especially considering the intimate, and often layered, nature of narrating the art making experience. Furthermore, the semi-structured interview allows the interviewer to identify and probe new emerging lines of inquiry that are related to the phenomenon being studied. Since the EEG sessions of this study were conducted in the artists' studios—deemed highly private spaces—it seemed natural for the semi-structured interviews to be conducted in person, in the same private studio spaces.

Dietrich (2004a) listed and interrogated Csikszentmihalyi's nine main elements of flow, thereby identifying the possible neurocognitive mechanisms that underlie the flow state. Dietrich (2004a) provided an important reconceptualised framework of flow that brought the concept, described thus far in purely psychological terms, into contact with cognitive science and neuroscience. The primary focus of the interviews was thus not to retest whether the elements of flow related to neurocognitive mechanisms, but rather to establish whether, during art making, the artists experienced any of the main elements of flow. If they did, the particular flow experience was rated on a five-point Likert scale, either from weak to strong, or from never to always. Figure 2 offers a summary of the artists' responses to all nine flow elements, followed by the artists' verbatim responses to the experience of time whilst experiencing flow.

Flow elements	AA	AB	AC	AD	AE
Autotelic experience	Strong	Strong	Strong	It varies	Strong
Balance of challenge and skills	That is the imperative!	Always	Always	Always	Always
Progression of small actions leading to larger action	That is what you hope for	Strong	Strong	Strong	Strong
Unambiguous and immediate feedback	Always	Always	Always	Always	Always
Total concentration	During the last 10% of the work, it is very high	Strong	Strong	Strong	Strong

Merging of action and awareness	Strong	Strong	Strong when mood is integrated by all the senses	Sometimes, depends on how 'fit' I am	Strong
Speeding up or slowing down of time	Strong	Strong	Like an altered state of consciousness	Work is compulsive - time is sometimes fragmented	Strong
Sense of control	In and out of control is still flow	Strong	Strong	Strong	Strong
Loss of concern for the self	Strong	Strong	Strong	Mindless at times	Strong

Figure 2
Artists' responses to nine elements of flow which were posed as questions of relatedness to their experience of art making. Flow elements related to the experience of time are tinted in grey (source: the author).

All five artist described six of the nine flow elements as "strong/always". This points to the experience of flow as having a strong association with an altered state of consciousness, of which the speeding up or slowing down of time is a hallmark. As the focus of this article is the restructuring of temporality, verbatim responses to questions related to the experience of time are noted below.

Are you aware of experiencing total concentration of the task at hand? In other words, do you experience such concentration to the exclusion of most anything else?

- Artist AA: You do become submerged in the state. But it is as if things struggle to the surface. Even during the moment of flow peripheral stuff happens – remembered responsibilities, obligations. Towards the end of a work I experience flow – when things are coming right – the last 10% of a drawing my concentration is very high.
- Artist AB: Yes, strongly. But it is transient, but equally easy to get 'back in there'.
- Artist AC: Yes. Always.
- Artist AD: Yes – it is strong.
- Artist AE: Yes, I am strongly aware of that, but I'm often aware [in the greater scheme of things] of a fight against time.

The next question is related to the previous one and has to do with a merging of action and awareness – would you say that as a result of such concentration that your experience is 'in the moment' and focused on what is being done?

- Artist AA: Yes, very strongly.
- Artist AB: Yes, strongly. Again, as for the previous question - it is transient, but equally easy to get 'back in there'.
- Artist AC: Music can be a catalyst. Mood is integrated by vision and the auditory.
- Artist AD: The fitter you are – you remember all the 'tricks', so it varies.
- Artist AE: Yes, strongly.

Are you ever aware of a speeding up or slowing down of time?

- Artist AA: Yes, strongly aware. Time 'becomes' – passes easily.
- Artist AB: Yes. There is *no time*.
- Artist AC: Yes. There is no consciousness of time. It is like altered states of consciousness. I am not aware of time and just don't experience fatigue.
- Artist AD: Yes, I am strongly aware of time distortions.

- Artist AE: The actual physical work has its own iteration – it is compulsive and sometimes fragmented. I'm often aware of not being relaxed, so perhaps I am aware of time restraints.

Semi-structured interview findings

Four out of five artists expressed strong experiences of time being distorted, of time speeding up, or of not being aware of the passing of time. This experience is connected with full concentration of the task at hand and the perception of a merging of action and awareness. In most instances all five artists agreed strongly/always as to the experiences described above, and to their interconnection. As mentioned in the introduction, because of the difficulty in localising the internal clock within the brain, timing and time perception has struggled to separate itself from the study of other cognitive processes such as attention/concentration and memory.

Conclusion

Time, undeniably, is a dimension of the physical universe. As has been illustrated in this article, how humans experience it is subjective. Wyllie (2005: 173) suggests that "some psychopathologic experiences have as one of their structural aspects the experience of restructured temporality." Here he refers to lived time as one of the universal microstructures of experience –

> [L]ived time is connected with the experience of the embodied human subject as being driven and directed towards the world in terms of bodily potentiality and capability. The dialectical relationship between the embodied human subject and the world results in a sense of lived time (personal time)… (Wyllie 2005: 173).

This article explained how distortions of time can be experienced due to severe psychpathologic disorders as a result of brain lesions or disease. In addition flow, an altered state of consciousness, was identified neuroscientifically as transient hypofrontality, which can result in restructured temporality. But such restructured temporality, identified as time speeding up or slowing down or not existing at all, occurs during states of highly focused concentration and often yields fascinating expressions of science and art, performed by highly skilled individuals who are able to control stepping in and out of the here and now at will. Indeed, art making in flow could be regarded as an induction method for experiencing the benefits of restructured temporality.

Notes

1 Here the ego refers to Freud's description of the organised realistic part of the mind (whereas the "id" refers to the uncoordinated instinctual trends and the "super-ego", to which the critical and moralising function of the mind are attributed) (Freud 1984).

2 Rovelli (2016) in a fascinating explanation about quantum gravity cautions that we must not think of time as if the life of the universe is marked by a great cosmic clock – indeed, every object in the universe has its own time running where the local gravitational field is the determinant factor.

3 Even though empirical studies have come a long way to explain human art making, it should be borne in mind that decisions that artists make during art making may be largely of a formal nature and thus based on their experience and knowledge of the discipline. In other words, even though the brain may have areas specific for, say, upright human faces, and may explain changes in approach to portraiture based on pre- and post-trauma brain lesions in artists, the choices that a "healthy" artist makes during art making do not necessarily directly link with current empirical scientific findings.

4 Phenomenology, especially in continental Europe, adhered to a non-scientific approach to the study of the mind. "This ideology reached its peak at the turn of the [twentieth] century…" (Dietrich 2007c: 25). It is now accepted that there is no specific location or time in which consciousness happens.

5 Banich (2004: 155) states that damage to (especially the lateral zone of) the cerebellum results in impairment in motor movements, cognitive functions as well as determining the temporal duration of events, as well as the relationship between successive events – "Rather than providing a single central clock that keeps a running track of time, as would a pacemaker, the cerebellum appears to contain a wide range of interval-type timers". Such timers can vary, for example, from 300ms to 500ms.

6 Not directly pertinent to this article, but of interest is the description by Solms and Turnbull (2004: 101-104, 171, 173) of damage to the ventromesial quadrant of the frontal lobes (for example due to chronic alcoholism) as resulting in a loss of executive control, memory loss, replacement of external by psychical reality with, often, concomitant sense of timelessness. They cite clinical cases that illustrate the capacity of the 'ego' to inhibit instinctual drives, which they refer to as the very foundation of rational, reality-constrained behaviour – to be bound up with the functions of the ventromesial frontal lobes.

7 However, there are situations where an overextension of stepping out of the here and now can be debilitating – an example is obsessive-compulsive disorder.

8 Pope and Singer (1978) offer an evolution of scholarly and scientific views on consciousness; Gazzaniga (2004: 1105-1210) offers various neuroscientific perspectives on consciousness.

9 According to Damasio (1998:1880), awareness is designated to "core consciousness". "Extended consciousness" (or consciousness proper) depends on core consciousness, and portrays more than the present state of the organism, but also its past and future.

10 Crick and Koch (2004: 1134) refer to the cortical system as the cerebral cortex plus other regions such as the thalamus and the claustrum, also the basal ganglia, the cerebellum, inclusive of widespread brainstem projection systems.

11 Crick and Koch (2004: 1134) suggest that the terms frontal and prefrontal can be ambiguous. An operational definition is that the front is all the parts of the brain "that receive a significant input, via the thalamus, from the basal ganglia".

12 Dietrich (2008b) disagrees with the notion that motor imagery (in the case of art making, visualisation of an art work) can be used as a proxy for real motor performance. He explains that sensorimotor integration, in real time, requires significant amounts of 'number crunching' for the brain. Mostly lower brain centres control a movement such as walking or moving the arms, which is well automated. The brain must control millions of muscle fibres to precise specification, making this process computationally and metabolically very costly. In terms of the brain's motor system, a number of structures devoted to movement are involved representing a significant amount of brain volume, as well as a high percentage of neurons (Dietrich 2008b).

13 Electrodes over the left hemisphere are labelled with odd numbers, those over the right with even numbers and those on the midline with a 'z'. The uppercase abbreviation indicates the location of the electrode: A, auriole; C, central; F, frontal; Fp, frontal pole; O, occipital; P, parietal; and T, temporal.

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Notes

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