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Off the Lip Conference - Transdisciplinary Approaches to Cognitive Innovation. Conference Proceedings

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Proceedings

Plymouth University, CogNovo and Transtechnology Research

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OFF

THE

7-11 September 2015

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LIP

**Transdisciplinary
Approaches to
Cognitive Innovation**

Conference Proceedings



COGNOVO



transtechnology research

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Off the Lip: Transdisciplinary Approaches to Cognitive Innovation.

September 7-11 2015

The promise of cognitive innovation as a collaborative project in the sciences, arts and humanities is that we can approach creativity as a bootstrapping cognitive process in which the energies that shape the poem are necessarily indistinguishable from those that shape the poet. For the purposes of this conference the exploration of the idea of cognitive innovation concerns an understanding of creativity that is not exclusively concerned with conscious human thought and action but also as intrinsic to our cognitive development. As a consequence, we see the possibility for cognitive innovation to provide a theoretical and practical platform from which to address disciplinary differences in ways that offer new topics and concerns for research in the sciences and the humanities. (Off the Lip Conference Programme. September 2015)

In the trajectory of human biological, social and cognitive history, creativity has marked out a watershed that has allowed us to register a profound potential in antiquity that can offer guidance and quality to the present. In this respect that present has its firmest foundation- birth perhaps- in the various manifestations across the world of what we like to call (from our Eurocentric perspective) the Renaissance. However we may now feel about that historical category and periodization, our current understanding and valorization of the human quality of creativity is defined by the interventions of individuals who considered the world around them and thought that it could better reflect the experience of the individual. Those moved

to action had to do two things that hitherto had been thought of quite separately: they had to find ways of representing those aspects of human experience that were valuable (and worth representing) and- perhaps more important – had to dig deep within themselves to understand what it was that, at the experiential and phenomenological level, drew perception and representation into a coherent communicable gesture. In this way creativity became inextricably entwined with value, most radically, in as much as it detached the absolute authority of quality from the history of antiquity. In this way creativity and novelty became two of the markers of individual liberation and human autonomy. To be sure the attempted institutional containment and harnessing of such freedoms appears to have provided the catalyst for a resistance that, over the past six centuries, has simply stoked the fires to the extent that protest and creativity became synonymous as the avant-garde. For some, such a cultural determinism of creativity is perhaps a step too far, and the insight and driver of CogNovo and this conference has been to question, as we do in the quotation from the Off the Lip conference flyer above, if the spurs of creativity might not also derive from aspects of human biology, and human cognition. Whether creativity in the social and economic realm might only be a legible manifestation of a neural property or cognitive habit.

This is our research project and the Off the Lip Conference and the papers in this collection provide a trace of both the diversity and the singularity of our enquiry. This is our first conference and as such these are relatively early days in the project and there is freshness and excitement. Nevertheless, for those of us fortunate to be able to share in the collective research of our community on a daily basis it certainly does have the feel of a solid secessionist movement, the likes of which have shaped the story art science and culture for the last 600 years. At least in the version of that story as it appears in the dominant literature that offers progress and coherence through the apparently inexorable human appeal of novelty. This points to the compelling fascination of CogNovo in that it touches (and challenges) both our knowledge and assumptions about our cognitive capacities and the valorization of creativity as a criteria of representational competence.

The Off the Lip conference and workshop was made possible by the many individual and collective efforts of the researchers, their supervisors, and presenters and we give them our thanks for making it such a valuable ideas exchange. Most of all, however, most of us will remember that it was led by Dr Martha Blassnigg who we are all grateful to have had the great good fortune to know.

Michael Punt, Sue Denham

January 2016

Off the Lip was a collaboration between CogNovo and Transtechnology Research, at the Cognition Institute, University of Plymouth.

CogNovo is an Innovative Doctoral Programme, funded by the EU Marie Skłodowska-Curie Actions initiative and Plymouth University, to foster research training in the emerging field of Cognitive Innovation. CogNovo offers transdisciplinary training that combines scientific studies of the neural correlates and mechanisms of creativity, with investigations into the role of creativity in human cognition, and their application in sustainable technological and social innovation. 25 international PhD candidates work within a network of over 50 partners in research and industry all over the globe.

Transtechnology Research is a transdisciplinary research group situated in the Faculty of Arts and Humanities. Its constituency is drawn from historians, philosophers, anthropologists, artists and designers and is led from a historical and theoretical perspective with the objective of understanding science and technology as a manifestation of a range of human desires and cultural imperatives. Its aim is to provide a doctoral and post-doctoral environment for researchers who need to undertake academic research informed by their own and others creative practice. Its overarching research project concerns the historical and philosophical aspects of science and technology and the popular arts.

[A Note on Presentation.

The papers are printed here as they were submitted by the authors and this means that there is some slight variation in style. The contribution by Martha Blassnigg is taken from her hard drive, and consists of what we believe were the lecture notes used on the occasion of the conference. (eds.)]

Creative Mind and Evolution in Bergson's Philosophy: the Self as Technology

Dr. Martha Blassnigg

Transtechology Research, Plymouth University

As many will know, Dr Martha Blassnigg was one of the driving forces behind the concept and delivery of Off The Lip. We are however, fortunate to be have access to the presentation notes for the paper that she delivered at the conference and we have decided to publish it here unedited.

For this paper I took as a starting point the observation that the way creativity is studied in psychology often heavily relies on an adequate ability of self-assessment by the participants (see creativity questionnaires). How humans know themselves and how this perception might be trained will be explored with regard to the philosophy of Henri Bergson in connection with a side-step into the innovative scientific visualisation by Etienne-Jules Marey.

An outstanding mathematician in his youth and consequently philosopher (later active in the diplomatic service), Bergson referred to the processes of the mind and to the evolution of consciousness as “creative”, which he understood as a particular tendency of the mind in its durational quality, as something that is “productive of effects in which it expands and transcends its own being” (Bergson, *Creative Evolution* p. 52). This is how I would like in the following to approach the term ‘cognitive innovation’ situated in relation to Bergson’s understanding of cognition as embodied and enactive, as creative processes involving agency, choice and action.

In his second major work, *Matter and Memory* (*Matiere et Memoire* 1896) Bergson delved into the question how novelty comes about in his study of the relationship between matter and spirit (body and mind) by drawing

on the latest scientific findings with regard to the psychology of perception such as experimental psychophysiology by Wundt (1874), hysteria and hypnotism by Pierre Janet (1894, 1898, 1903), or research into the unconscious and psychic conditions by William James (1950, 1986) or Breuer and Freud (1891). By using clinical data from pathology and psychophysiology, such as memory disorders of aphasia and amnesia, Bergson developed his proposition that memory, and consequently the mind, acts upon the body but is not predetermined by it and hence has to be regarded as independent, in other words: different in kind. He situated novelty in the constant renewal of memory impinging on perception. Memory, in his view, was an extension from the past into the present; he considered it as a forward moving momentum. Bergson treated recollection as an actualisation of *memory-images* that were evoked through a tension of consciousness towards the requirements of the present moment of perception and action.

According to Bergson, *memory-images* impinge on the present moment and overlap with perception, as a constant act of molding the past into the present. A few decades later the behaviourist psychologist Hugo Münsterberg takes this up in proposing that during the perception of a movie: “The best does not come from without” (1916: 31); and he puts it even more strongly; the movies — at the time called “the photoplay” — “...obeys the laws of the mind rather than those of the **outer** world” (1916: 41). Bergson established that perception itself takes place in the perceived object by way of an extended conscious process of a “reciprocal interpenetration.” (1998: 178) In this way memory is constantly reshaping itself in the present as part of a tension of the whole of the personality as it is enacted: selected, remembered and acted upon, ideally steered by will and intention. Bergson (1999: 40) used the term duration for this and explains:

... there is no state of mind, however simple, which does not change every moment, since there is no consciousness without memory, and no continuation of a state without the addition, to the present feeling, of the memory of past moments. It is this which constitutes duration.

This duration relates to time as it is experienced, as a certain quality in consciousness which is continuous and indivisible, in itself multiplicity and

potentiality. Mathematical time instead, so Bergson famously, is divisible into units or intervals that do not reflect the flow of actual time experience. [SLIDE 1]

Etienne-Jules Marey's work can be regarded as exemplary for the challenge that both he and Bergson faced: the tension between habit/repetition and novelty/innovation which is tangible in his scientific visualisations that he envisaged as technological innovations to extend the limited capacities of human perception.

[SLIDE 2]

Marey's chromophotographic movement capture superimposed instances of motion from a single point of view on image strips without frames, in order to capture increasingly smaller instances of motion to analyse the physical manifestation of the body's underlying forces from which movement originated.

[SLIDE 3]

As I have more fully discussed elsewhere (Blassnigg 2009), Marey not only pursued a vigorous interest in aesthetics in the development of photographic techniques as a scientific analytic tool, he also envisaged his unique method as a training tool for the artistic reconstruction of a perceptual experience. In 1893 he published a catalogue with his laboratory assistant George Demeny entitled *Etudes de Physiologie Artistique Faites au Moyen de la Chronophotographie* foreseen as scientific training of perception for artistic expression and the study of anatomy. (Braun 1992: 269) Whilst on the one hand it can be said that Marey held a rather conventional understanding of art practice, he was on the other hand conscious of the potential aesthetic impact of instantaneous photography (ref Muybridge): "How will this education of the eye end, and what will be the effect on Art? The future alone can show." (Marey 1895: 183)

[SLIDE 4]

During the later part of his career Marey increasingly eradicated spatial and formal features for the sake of a more direct engagement with processes of time. This is particularly evident in his geometrical chromophotography of motion capture. Here perception becomes an affective engagement where the beholder's body reflects on itself, similar to the way that Jonathan Crary has proposed with regard to the perception of Turner's paintings of the

sun. He notes how Turner's later more abstract paintings lodge the experience of the observer amidst an "inescapable temporality" (Crary 1990: 138) through the loss of a fixed source of light, whereby the body of the beholder takes over as the source of its effects, as the "'visionary' capacities of the body" (141). The affect, Bergson proposed, is the body's response to perception in preparation of an action:

Suppose the distance reduced to zero, that is to say that the object to be perceived coincides with our body, that is to say again, that our body is the object to be perceived. Then it is no longer virtual action, but real action that this specialized perception will express, and this is exactly what affection is. (Bergson 1991: 57)

Against the background of the international introduction of universal time in the 1890s and discussions around relativity, Bergson proposed that time **acts**; — if nothing else it: "... hinders everything from being given at once" (1992: 93). He speculated how real time eluded mathematical treatment and considered that this particular duration that science eliminates — and which is so difficult to conceive and express — is what one feels and lives. (1992: 13)

Time is immediately given. That is sufficient for us, and until its inexistence or perversity is proved to us we shall merely register that there is effectively **a flow of unforeseeable novelty**. (1999: 105)

Bergson recognised the artist's ability to catch the moment of transition exemplary for the workings of cognition as a creative act within the temporalities of indeterminacy. The artist in the best cases epitomised the artisan who Bergson recognised in each human, in the creative impulse as key driver of life in its multiplicity and development of consciousness. Born as both artisans and geometricians in a metaphorical sense, as geometricians humans reject the unforeseeable; as artisans (or artists) humans accept indeterminacy drawing on creation and spontaneity. These two processes he saw as complementary, as belonging to the two opposed tendencies of the human mind:

intellect and intuition. In this sense Bergson understood human beings as continuous creators and inventors within the tension between spirit and matter (or the virtual and the actual); and memory as the “material furnished us by the past and present, by heredity and opportunity” to create the novel and unforeseeable, “as the form given by the sculptor to the clay.” (1992: 93-94).

Bergson consequently suggested a complementary aspect to the scientific method, that of philosophical or aesthetic intuition as a way to grasp the creative flow of this duration, life in its making and constant becoming, as distinguished from conceptual thinking by the intellect; these two opposed tendencies of the mind, when combined, produced a dynamic knowledge of reality that recognised both, the necessity of temporary fixation and intersection (language, technology etc.) and the continuous potential of multiplicity and novelty in the creative pulse (*esprit*) in all motion. It was, in his vision, a complementary coming together of science and metaphysics in a collaborative effort.

So understood, philosophy is not only the turning of the mind homeward, the coincidence of human consciousness with the living principle whence it emanates, a contact with the creative effort: it is the study of becoming in general, it is true evolutionism and consequently the true continuation of science—provided that we understand by this word a set of truths either experienced or demonstrated, and not a certain new scholasticism that has grown up during the latter half of the nineteenth century around the physics of Galileo, as the old scholasticism grew up around Aristotle. (1998: 369-370)

Philosophical (or aesthetic) intuition Bergson did not conceive as a single act (a spark of insight for example), but rather as a strenuous effort of heightened concentration to suppress action momentarily, in order to achieve an increased awareness of pure perception — that is: the inner quality as it endures in living beings, within the self as in the ‘other’, in all things, objects included. As Bergson reaffirms in *The Creative Mind* (1992: 88), intuition has nothing to do with relaxation, it is a form of reflection through psychological attention that extends perception in intensity and

awareness. For Bergson the role of the body was to reproduce in action the life of the mind: “to emphasize its motor articulations as the orchestra conductor does for a musical score”; the brain’s function respectively was not to think but that of hindering the thought from becoming lost in dream; it was the organ of attention to life.

Installed in universal mobility, (...) consciousness contracts in a quasi-instantaneous vision an immensely long history which unfolds outside it. The higher the consciousness, the stronger is this tension of its own duration in relation to that of things. (1992: 89)

What follows from this is that there is no perception that is not constantly modified — *in media res* (in the midst of action) —; the externally perceived and our own person is in a constant flow of mobility. The present is perpetual; it endures. Perception, in Bergson’s view, is “a certain regulation of mobility on mobility which produces the effect of immobility”. As a consequence, the perception of matter was no longer either relative or subjective or apart from affection and especially from memory, but merely dissevered by the multiplicity of one’s needs and intentions. (1991: 49-50) Bergson concludes that the relation between the ‘phenomenon’ and the ‘thing’ is not that of appearance to reality, but merely that of the part to the whole (MM, 306). In other words, perception gives us access to matter itself, in its reality, but we only consciously perceive those parts of it that have bearing on our actions.

When we put back our being into our will, and our will itself into the impulsion it prolongs, we understand, we feel, that reality is a perpetual growth, a creation pursued without end. Our will already performs this miracle. Every human work in which there is invention, every voluntary act in which there is freedom, every movement of an organism that manifests spontaneity, brings something new into the world. True, these are only creations of form. How could they be anything else? We are not the vital current itself; we are this current already loaded with matter, that is, with congealed parts of its own substance which it carries along its course. (1998: 239)

Perception here is not understood as a dual-channel process of incoming

and outgoing stimuli and response, neither is it a mere projection of internal states (or a one-directional reflection of bodily states on mental acts). Bergson emphasised instead the partial coincidence in a moment of pure (disinterested) perception in 'the object to be perceived', overridden by the impinging of memories and affections that merge with the perceived *image* (understood as fully sensory percepts). As such it constitutes a dynamic process within the mind in its constant self-creation in osmosis with its enaction in the given environment.

Although current developments in the cognitive sciences repeat or confirm aspects of Bergson's philosophy as well as reaffirm some of his criticism, the particular resonance of his thought lies in the treatment of the profound human experience in face of the unrecoverability of the mobile present and flow of time and, most importantly, in the recognition of a certain amount of control or 'agency', in the co-constructive processes of perception that straddle the opposing and yet mutually interdependent tendencies of the creative impulse from spirit to matter. Moreover, he laid out a vision for the potential of a continuous development and expansion of conscious awareness within the mind's productive "effects in which it expands and transcends its own being" (1998: 52).

Finally, consciousness is essentially free; it is freedom itself; but it cannot pass through matter without settling on it, without adapting itself to it: this adaptation is what we call intellectuality; and the intellect, turning itself back toward active, that is to say free, consciousness, naturally makes it enter into the conceptual forms into which it is accustomed to see matter fit. It will therefore always perceive freedom in the form of necessity; it will always neglect the part of novelty or of creation inherent in the free act; it will always substitute for action itself an imitation artificial, approximative, obtained by compounding the old with the old and the same with the same. Thus, to the eyes of a philosophy that attempts to reabsorb intellect in intuition, many difficulties vanish or become light. But such a doctrine does not only facilitate speculation; it gives us also more power to act and to live. For, with it, we feel ourselves no longer isolated in humanity, humanity no longer seems isolated in the nature that it dominates. As the smallest

grain of dust is bound up with our entire solar system, drawn along with it in that undivided movement of descent which is materiality itself, so all organized beings, from the humblest to the highest, from the first origins of life to the time in which we are, and in all places as in all times, do but evidence a single impulsion, the inverse of the movement of matter, and in itself indivisible. All the living hold together, and all yield to the same tremendous push. The animal takes its stand on the plant, man bestrides animality, and the whole of humanity, in space and in time, is one immense army galloping beside and before and behind each of us in an overwhelming charge able to beat down every resistance and clear the most formidable obstacles, perhaps even death.

To a certain extent, Bergson's philosophical (or aesthetic) intuition reminds of Michel Foucault's call for the "technology of self" from a lecture in 1982, defined as specific technique that human beings use to understand themselves:

...technologies of the self, which permit individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality. (1988)
(<http://foucault.info/documents/foucault.technologiesofself.en.html>)

[SLIDE 5 Modern art]

In view of Marey's legacy in modern art, it becomes paramount that both the technological as well as artistic expressions can be regarded as potential tools for the training of perception and cognitive creativity in action, embedded within the inherent tensions and contradictions of the larger *dispositif* of their production, distribution and interpretive frameworks. Through a Bergsonian lens, Foucault's notion 'technology of self' further stimulates to uncover the intrinsic strands of mental health and well-being in the engagement with media technologies, to be regarded as vehicles to train, stimulate or manipulate the creative mind in its perceptual engagement. From the perspective of the viewer's active co-construction of perception, Bergson's

philosophy reminds us of the immanent necessity that turns any archaeology of media to a self-aware engagement with cognition and the creative mind in action; forever dynamic in its making and unmaking of itself. The question I am further on developing is whether Bergson's understanding of dynamic memory and his conception of philosophical or aesthetic intuition can serve as a tool kit to train awareness in perception, as a tool to enhance how human beings understand themselves — as ways to collaborate with self and others more effectively.

References

- Bergson, Henri. [1912] 1999. *An Introduction to Metaphysics* (tr. T.E. Hulme). Indianapolis, Cambridge: Hackett Publishing. [French original: 'Introduction à la Métaphysique' in *Revue de Métaphysique et de Morale*, January 1903]
- ___ [1946] 1992. *The Creative Mind: An Introduction to Metaphysics* (tr. M. L. Andison). New York: The Citadel Press. [French original: 1934. *La Pensée et le Mouvant: Essais et Conférences*. Paris: Alcan].
- ___ [1911] 1991. *Matter and Memory* (tr. N.M. Paul and W.S. Palmer). New York: Zone Books. [French original: 1896. *Matière et Mémoire: Essai sur la Relation du Corps à l'Esprit*. Paris: Alcan].
- ___ [1911] 1998. *Creative Evolution* (tr. A. Mitchell). Mineola, New York: Dover Publications. [French original: 1907. *L'Évolution Créatrice*. Paris: Alcan].
- Blassnigg, Martha. 2009. *Time, Memory and Consciousness and the Cinema Experience: Revisiting Ideas on Matter and Spirit*. Amsterdam: Rodopi Press.
- Böhme, Hartmut. 1997. 'Aby M. Warburg (1866-1929)' in Michaels, Axel (ed.) *Klassiker der Religionswissenschaft: Von Friedrich Schleiermacher bis Mircea Eliade*. München: C.H. Beck: 133-157.
- Braun, Martha. 1992. *Picturing Time: The Work of Étienne-Jules Marey (1830-1904)*. Chicago University Press.
- Crary, Jonathan. 1990. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge, Massachusetts: The MIT Press.
- ___ 1988. 'Techniques of the Observer'. *October*, Vol. 45 (Summer), pp. 3-35.
- Daston, Lorraine and Galison, Peter. 2010. *Objectivity*. Cambridge, Massachusetts: The MIT Press.

- Fabian, Johannes. 2007. *Memory Against Culture: Arguments and Reminders*. Durham and London: Duke University Press.
- Foucault, Michel. 1988. 'Technologies of Self', edited by Luther H. Martin, Huck Gutman and Patrick H. Hutton, pp. 16-49. University of Massachusetts Press. Online at: <http://foucault.info/documents/foucault.technologiesofself.en.html>
- Goethe, Wolfgang Johann. 1840. *Theory of Colours* (tr. Charles Lock Eastlake). London: John Murray.
- Marey, Étienne-Jules. 1894. *Le Mouvement*. Paris: Masson.
- Marey, Étienne-Jules and Demeny, Georges. 1893. *Etudes de Physiologie Artistique Faites au Moyen de la Chronophotographie*. Première Série, vol. I. De mouvement de l'homme. Paris: Berthaud.
- Michaud, Philippe-Alain. 2004. *Aby Warburg and the Image in Motion* (tr. S. Hawkes). Cambridge, Massachusetts: The MIT Press.
- Punt, Michael. 2000. *Early Cinema and the Technological Imaginary*. Trowbridge, Wiltshire: Cromwell Press.
- Semon, Richard. 1904. *Die Mneme als Erhaltendes Prinzip im Wechsel des Organischen Geschehens*. Leipzig: Engelmann. (Engl. Tr.: 1921. *The Mneme*. London: George Allen & Unwin.)
- Warburg, Aby M. 2000. 'Der Bilderatlas MNEMOSYNE' in *Gesammelte Schriften* (ed. M. Warnke in collaboration with Claudia Brink). (Studienausgabe, Band II.1, 2.) Berlin: Akademie Verlag.
- . 1992. *Ausgewählte Schriften und Würdigungen* (ed. D. Wuttke). Baden-Baden: Valentin Koerner.

The Affective Embodiment of Testing Tools and Their Influence on Experimental Outcomes

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Intro

In psychological research designs, experimental validity is pivotal, often at the expense of ecological validity or ‘realism’ (Wilson et al., 2010). In the early 1970s, the field of psychology was heavily criticised as a result of this artificiality; how could people trust the outcomes of these experimental setups if they were obscured from reality (Kuper, 2013)? In order to protect the value of laboratory experiments, Aronson and Carlsmith (1968) argued that the above point was moot and that it should not be the concern of the experiment to “emulate reality...” but rather “...to reveal what lies beneath the surface of reality” (Pelham & Blanton, 2012, p.219). In this paper we will discuss the importance of ‘emulating reality’ through production processes, integrating insights from psychology as well as the arts in order to offer a novel perspective on the development of tools used in experimental settings. We start with a general overview of issues associated with the study of mental phenomena and move onto the specificities of assessment in the domain of moral psychology.

The traditional methodological framework used in the study of psychological phenomena is a systematic and rigid extrapolation of rules pertaining to experimental procedures used in the sciences. Psychology however is not just grounded in the so-called pure sciences, but rather its boundaries

also bleed into disciplines such as philosophy and physiology. Despite this, psychology often lacks an integrative approach to the development of its working processes. The design systems put in place for the production of experimental tools seems to be missing an inductive approach, often found within design research, one in which the output and its effect on the user is interrogated with extreme subtlety.

This interrogative design approach could be applied to the manufacturing of experimental tools through a methodological system such as ‘research through design’ practice, a term coined by Christopher Frayling (Frayling, 1993). One in which the production and testing of these tools is a process which runs fluidly in parallel to their application. The focus being on the evaluation of the existing artefacts to formulate understanding of the research topic, in this case portrayed in Frayling’s anecdotal quote, “*How can I tell what I think till I see what I make and do* (p.5)?” This further emphasis towards the assessment of fabricated materials may yield an increasingly exhaustive critique of experimental tools, as well as influence the validity of experimental results.

Context

Modern psychology has emerged from earlier philosophical enquiries but now hinges on scientific research methods. For example, in social psychology, the collective methodology practised to gather information about an individual’s personality is to administer self-report assessments; mental phenomena are often assessed by presenting participants with questionnaires or fictional narratives. These hypothetical scenarios attempt to quantify people’s attitudes, perceptions, beliefs, and norms (Finch, 1987), willing the participant to imagine themselves in a situation which would otherwise be sensitive and difficult to recreate¹. The challenge here is to gain insightful results often on the basis of the participant’s ability to imagine themselves within fictitious imitations of reality. The majority of these approaches have been designed with replicability of findings and generalizability of results in mind.

Unfortunately, these concerns have overshadowed other design consider-

ations, generating assessments that are often artificial in nature and house little subtlety with regards to their true intentions. Consider the synthetic approach of attempting to assess creative potential through questions that can only be answered on a Likert scale ranging from 1 to 5. A more in-depth example of self-assessment can be seen in artists Susana Cámara Laret and Mike Thompson's 'Aqua Vita Project,' (2012) in which they worked with the Netherlands Metabolomics Centre as well as undergoing a Chinese Constitution examination to form the basis of a structured personal questionnaire. These sorts of personalised examinations might be harder to gauge within mass experimental settings without the methodological restraints put in place to prevent the risk of testing an ulterior or unconstrained influence.

Despite this demand for a high degree of control, decisions cannot be made in a vacuum and psychological processes are often influenced by a range of factors that cannot be conveyed within traditional experimental set-ups. The embodiment framework, for example, claims that all psychological processes are influenced by body morphology, sensations, movements and emotions. This coevolution of body alongside its cognitive processes suggests that a separation of the two would be unrealistic. Behaviour is not solely produced by a disembodied Cartesian mind, but rather it is influenced by direct interactions with the physical world and mediated through the body (Glenberg, 2010). This phenomenological approach is an important aspect in composing research design, where the focus of the design is the participant's subjective experience of the scenario.

In psychology, this simulacrum of reality was originally coined as 'Mundane realism,' describing the experiments that physically resembled the real world (Aronson & Carlsmith, 1968). Although this approach provided some headway, Aronson and Carlsmith (1968) asserted that scientists should pursue a more compelling alternative; 'experimental realism' or the extent to which an experiment *feels* rather than looks real. This approach relies on the inclusion of real-world psychological components that increase the quality of a participant's experience (Pelham & Blanton, 2012) and to an extent, resonates with discourses from phenomenology regarding the value of subjective experience.

Corporeal simulations, in particular, have been promoted across other disciplines with the intent to improve truth to nature². The production of medical tools for simulations are affected mainly through the need for enduring tools that are cost effective; wholly designed for large institutions. Consider the facial design of the original 'Resusci Anne' which has visually developed only slightly since its initial conception by toymaker Asmund Laerdal in 1961. With the recent incorporation of multimedia simulations (Bauman, 2013) introducing sounds, objects and scenarios coupled with the onset of platinum grade prosthetic silicones, used by such artists as Patricia Piccinini, there is potential for hyper real prosthetics and simulations to be produced. The high-grade production of these materials not only mimics the skin aesthetically but also imparts a tactile quality and resistance found in human skin. Yet there is still a struggle to meet the believability and educational needs of trainee healthcare professionals even with the most advanced patient simulators. (Alinier et al., 2006)

In the social sciences however, these physical enquiries are often peripheral in methodological design. Whilst existing scientific methods have advanced our aspiration of unlocking the complex connections between the brain, thoughts and behaviours, the physical fidelity of testing tools is often neglected. Present-day tools often overlook the dynamic structure of real life situations and falsely assume that reading about a situation is analogous to physically acting it out (Giroto et al., 2006). In effect then, these

¹ Sieber and Stanley (1988) defined socially sensitive topics as instances in which there can be consequences for the participants in question. The research of attitudes and behaviours in relation to sensitive topics is important as it has the potential to challenge surmised views of the world. For example Kalaft and Gagliano (1993) used vignettes to study students' attitudes to suicidal peers, whilst Hughes (1998) researched drug injecting and the perceived risk of the human immunodeficiency virus.

² As Daston and Galison propose, the attempt to represent 'truth to nature' does not always specify a specimen represented exactly as found, but rather a *typus*; "It is an image of the characteristic, the essential, the universal, the typical..." (Daston & Galison, p. 20). In this case, the simulation is a form that is representative, for example, of the average human body. This type of representation still has the potential to look realistic, yet this realism is often sacrificed to produce an average, appearing stylised through not containing the quirks of a specific person.

measures solely convey self-reports of inner states that cannot often be fully understood by introspection. This problem, combined with the hypocrisy that saying versus doing are often disparate, creates a conundrum. The significance of this is paramount; how can we assess genuine and unaffected behaviours through testing tools that are so unmistakably contrived? How might insights from art and design practises support a shift within a science that has now come to be characterised by ‘self-reports and finger movements’ (Baumeister et al 2007)?

Method

In the fields of moral philosophy and moral cognition, moral decision-making is often assessed through hypothetical moral scenarios. In the classic ‘Trolley Problem’, individuals are faced with the switch dilemma and the footbridge dilemma (Foot, 1978; Thomson, 1985). In the switch dilemma, individuals are confronted with the decision of changing the direction of a trolley’s path to kill one worker on the tracks ahead instead of five workers. The footbridge dilemma, based on a similar premise, involves deciding whether to push a large person off a bridge onto the tracks below, in order to stop the approaching trolley from killing the five workers on the tracks ahead. These dilemmas are presented in text format as small vignettes with a time-limit put in place to constrain the decision-making process. With its implications referencing major ethical theories, philosophers and psychologists alike have admired the Trolley Problem.

From the footbridge dilemma specifically, arises physical enquiries. The scenario hinges on tacit physical knowledge; from the large person’s physical structure to the momentum with which his body might fall from a bridge. These affordances are also reflected in considerations of the potential velocity of the running trolley as well as the weighted impact at the climax of the narrative. The physicality of the dilemma transforms this ‘thought experiment’ into a physics enquiry of material understanding. The possibility that the ‘push’ of the participant, may not be strong or directional enough is a mathematical issue, almost as absurd as Julijonas Urbonas’ calculations for a speculative ‘Euthanasia Coaster’ (2010). An intent, in this case, to avert

mass death through murder, is dependant not only on morality but also on the participant's self belief to achieve such a feat. Yet from a methodological perspective, moral decision making in these complex scenarios is fundamentally restricted using questions such as "Is it morally acceptable to push the man off the bridge in order to save the five workers on the tracks?" and responses are either given using a forced binary option (yes, no) or via Likert scales (1 - not at all, 5 - definitely).

The resulting dichotomous data generated by this methodology is somewhat arbitrary in nature and lacks external validity, suggesting that it is not realistic or applicable to real-life. In this case the applicability would not be a vexing matter in the philosophical domain, given that the interests of this problem as a thought experiment lie in the outcomes of these as rhetorical devices (Bauman et al., 2014). However, within psychology, these dilemmas have become established methodological tools for assessing how people feel and behave in moral dilemmas. It is for this reason that the physicality of the problem holds such value.

Recently, interdisciplinary approaches have been employed to address concerns over the realism of these story-like dilemmas. Virtual Reality offers a way in which researchers can immerse participants in realistic simulations of life-threatening situations without compromising ethical boundaries in experimentation. The Oculus Rift has been experimented with greatly in computer games design and more recently, in arts practices as a sensory tool; it's questionable purpose, to alter the perspective of the user, is tested in Mark Farid's project 'Seeing I' (2015). From the project launch, Farid will live for one month solidly in virtual reality, streaming the life of another person and the effects on Farid will be documented by film director John Ingle. In a similar way, virtual reconstructions of the footbridge dilemma are presented to participants through headset devices creating a 110 degree and motion tracked field-of-view. This methodology allows simulations of actions to be recorded, as opposed to judgements, with participants able to respond through external devices such as joysticks or console controllers. This inventive approach has so far revealed, that individuals do respond differently when faced with virtual constructions of moral dilemmas compared

to those vignettes adopted by philosophers (Francis et al., 2015).

In terms of embodied perspectives, moral decision-making couples effectively with theories of embodied cognition in terms of experiencing particular sensations or feelings. Smelling a disgusting odour, hearing a disgusting noise or visualising a disgusting depiction are all likely to trigger the gastro-enteric nervous system (Schnall et al., 2008). Even the consumption of disgusting beverages has been observed to induce harsher moral judgements (Eskine, et al., 2011) This also corresponds to Damasio's somatic marker hypothesis in which he proposes that corporeal reactions to particular incidents become united and as such, merely anticipating a similar event results in an embodied 'as-if' response (Damasio et al., 1996). From a proximity perspective, exposure to extreme cold modulates moral decision-making in conflicting moral dilemmas (Nakamura et al., 2014). Physical coldness, induced via frozen water packs to the skin, resulted in a greater number of utilitarian decisions (choosing to push the man off the bridge); embodied perceptual theories argue that this physical coldness may have increased perceived social distance and reduced empathic concern (Nakamura et al., 2014).

Despite the advancement of these approaches, the tactile feedback from the use of controllers or other tools that measure reactions, still share little resemblance to the embodiment of realistic actions as well as physical engagement with the body of others and the environment. In the development of scenarios, such as the footbridge dilemma, an important aspect that has been overlooked is the sense of touch. Tactile experience has been highlighted as an important facilitating factor in behaviour and communication. From grooming in primates to lovers holding hands, it is suggested that touch is accompanied by emotional and sensory processes (Loken and Olausson, 2010). However, the affective and sensory experience of touch can vary depending on the facets of a texture; different textures are associated with a varying range of affective signals. It has been shown for example that textures are felt differently across different skin sites; touch on hairy skin (e.g. arm) is more emotionally rewarding than touch on glabrous skin (e.g. palm), due to the underlying neurophysiology of skin afferents. In addition to the tactile element, the kinesthetic experience of coming into

contact with another's body is also often overlooked. No where is the significance of physical affordances more relevant than in the field of morality. In *personal* dilemmas, sacrifices are driven by the agent's muscular frame (Greene et al., 2009). In the footbridge dilemma for example, the physical contact between the protagonist and the large man carries with it a direct transfer of bodily force (Cushman, 2013). For the protagonist, this corporeal sensation of pushing embodies a history of moral violations; this haptic perception alone could generate the moral condemnation for the action of pushing. And yet words written on paper cannot begin to convey the visual tactile synchrony that gives rise to the kinesthetic sensation of friction, stiffness and pressure that in turn relate to the iniquity of harming another. Haptic interactive design is therefore a requisite for emulating reality. Whether the influence of these physical features on moral decision-making is wholly the effect of embodiment on moral judgements has yet to be explicated in the field (Nakamura et al., 2014); the interplay between realistic tactile and haptic sensations of testing tools and moral behaviours awaits investigation.

Whilst the visual element of Virtual Reality adds richness to these moral dilemmas and embodied theory tells us that embodied tactile information can shape the processing of abstract domains such as morality, decisions are still arbitrary and tools for assessing moral decision-making remain distant in aesthetic character, haptic nature and tactile quality.

Results

There are a number of potential solutions that may give freedom to some of these experimental restraints. Including environment, as well as props, these aspects of an experiment may alter a participant's willingness to participate or cooperate within the guise of the experimental setting, as well as capitulate to the farce of an invented scenario. Each facet of the footbridge dilemma, from the sound of the train on the track, to the warmth of the human body being pushed should be a consideration in the overall experience of the participant. The potential for 'set design' here can be likened to more theatrical experiences such as Derren Brown's 'Apocalypse,' (Derren Brown, 2012) or perhaps even Punchdrunk's walking theatre event 'The

Drowned Man,' (Barrett, F., 2013); both of these interactive experiences offer their audiences the freedom to participate at their discretion. The restricted bounds imposed through experimental settings are also often liberated within a gallery environment; one in which experimentation can be expressed through performance as well as visuals. Spaces such as the Science Gallery Dublin, opening its doors to many collaborative sci-art projects, can lend alternative frameworks for collecting data that are not tethered to the bounds of psychology or scientific research. These settings offer a larger and wider range of participants, who are often more receptive to the purpose of the research, for example the collaborative project 'Free Will' by Dr Aoife McLysaght, Prof. Fiona Newell, Prof. Hugh Garavan, Prof. Luke O'Neill and Prof. Ken Wolfe is using the gallery space to test dopamine levels in spit in order to assess risk taking behaviours (Science Gallery Dublin, 2011).

Although, not all art-science projects are permitted through the guise of the gallery, Anna Dumitriu's series of events "Trust me I'm an artist, towards an ethics of Art and Science collaboration" (2015) queries the validity and ethical significance of proposed artworks by presenting them to a committee. Instigators of such collaborative research such as the Ars Electronica Future Lab, Bio Art and Design Awards and SymbioticA, highlight the benefit of collaborative research to enrich, challenge and expand traditional disciplinary approaches, yet mainly specialise in art to biology or physics based disciplinary collaborations. Exploring the tactile quality of psychological testing tools has yet to be incorporated in these vastly expanding topics of art research.

To address the constraints placed on the realism of moral dilemmas in the field of psychology, our multidisciplinary approach seeks to produce a testing tool that in itself, comprises the aesthetic and haptic richness of the human body. A tool that mimics the tactile perceptions of the flesh, could establish a physical coupling between experiment and participant; a quality essential to the exploration of intricate and momentous topics such as moral standing. This corporeal parallel might motivate participants to respond in these experimental contexts, in ways that are more authentic and unrestrained.

Implications

The emotionally provocative nature and abstract complexity of moral decisions, raises questions concerning the current physical restraints placed on their methods of assessment. At present, the transfer of bodily force and tactile sensation when pushing in the footbridge dilemma are predominantly imagined or visualised internally. As such, the significance of these physical affordances on the decision-making process remains shrouded. In order to emulate experimental as well as mundane realism in these scenarios, haptic and tactile interactive design must be incorporated to produce visual physical synchrony. In order to achieve this unification, a testing tool is proposed that encompasses tactile imitations of the flesh, aesthetic likeness and embodied haptic feedback.

The iterations of this tool's design process could result in an archive of textures, mechanisms and sculptures that in its media archaeological analysis, allows a selection of the most favourable for the circumstance. A process implicitly innate within arts technique, yet often only ever measured post hoc as opposed to throughout. Beyond the field of moral psychology and creative practice, the potential application of methodologies that incorporate physical realism could extend to other fields such as engineering, medicine and the military. High fidelity life-size simulation mannequins have already been shown to improve on-board care of naval casualties (Netzer, Weiss & Hoppenstein, 2015). However in reality, how would the feel of flesh combined with the sound of pain affect personnel's preparedness to engage in similar real life situations? In such training, the strive for maximum realism is conceivably paramount.

The considerations highlighted in this paper pinpoint that behaviour has frequently been obscured in favour of mental processes. It might therefore be appropriate to part from measuring internal responses exclusively, towards the integration of mental phenomena with the observation of physical behaviours in substantive settings. Constructing the prospective tool may facilitate these developments. Specifically, introducing a physical realism to interactions within moral dilemmas, could establish meaning-

ful engagements in scenarios often criticised for their hypothetical nature. Making accommodations within the existing methodology through tactile considerations could reveal behaviours previously hidden within the bounds of traditional experimental designs.

The traumatic nature of the dilemma in which we incorporate our testing tool, places constraints on the potential use of this proposed design. The sensitive and chilling nature of moral dilemmas prevents any experimental testing “outside of the lab” and whilst this research process offers advancements in the substance of these scenarios, we acknowledge that moral decisions are still made in a somewhat contrived landscape. Despite this limitation, this paper and the proposed speculations discussed, could advocate adaptations within the methodologies currently employed in experimental science. With the potential to encourage the application of alternative disciplinary methods, the movement towards an authenticity of representation could not only further our conviction in resulting outcomes, but also aid our comprehension of participants’ responses to representation within scientific tools.

Encompassing multidisciplinary perspectives, this paper has explored issues associated with the study of mental phenomena against the background of a traditional experimental set-up. In particular, this critique has examined the specificities of the assessment of moral decisions, with a focus on the physical nature of the footbridge dilemma. Methodological influences from design practice have framed this discussion within a novel structure in which aesthetic realism, haptic momentum, and tactile sensation have been introduced to the methodological design; an approach previously unexplored in the domain of moral psychology. Unanticipated considering psychology’s prolific contribution to the field of perception, with such detail as Rudolph Arnheim (1974), the introduction of this critique could offer a self-reflective aspect to the production of experiential material produced for psychology itself. One in which a ‘research through design’ approach to psychology (Frayling, 1993) can inform design research methods as well as research design applications.

References

- ALINIER, G., GORDON, R., HARWOOD, C., HUNT W.B. (2006) 12-Lead ECG training: the way forward. *Nurse Education today*, 26, 87-92.
- ARONSON, E. & CARLSMITH, J. 1968. Experimentation in social psychology In G. Lindzey and E. Aronson (Eds.), *The handbook of social psychology* (2d ed., Vol. 2, pp. 1-79). Reading, MA: Addison-Wesley.
- BARRETT, F., DOYLE, M. (2013). *The Drowned man: A Hollywood Fable*. Directed by Barrett, F., Doyle, M. Punchdrunk Temple Studios, London. [5 June 2014]
- BAUMAN, E. (2013). *Game-based Teaching and Simulation in Nursing and Health-care*. Springer Publishing, LLC. p.1995.
- BAUMAN, C. W., MCGRAW, A. P., BARTELS, D. M. & WARREN, C. 2014. Revisiting external validity: Concerns about trolley problems and other sacrificial dilemmas in moral psychology. *Social and Personality Psychology Compass*, 8, 536-554.
- BAUMEISTER, R. F., VOHS, K. D. & FUNDER, D. C. 2007. Psychology as the science of self-reports and finger movements: Whatever happened to actual behavior? *Perspectives on Psychological Science*, 2, 396-403.
- BROWN D. (2012) Part 1-2' Apocalypse, Series 1, episode 1-2, BBC2 Television , 26 October, 2 November.
- CAMARA LERET, S., THOMPSON, M., (2012) The Aqua Vita Project [mixed media] Aqua Vita Project [online]. Available at <http://theaquavitaproject.com>
- CUSHMAN, F. 2013. Action, outcome, and value a dual-system framework for morality. *Personality and social psychology review*, 17, 273-292.
- DAMASIO, A. R., EVERITT, B. & BISHOP, D. 1996. The somatic marker hypothesis and the possible functions of the prefrontal cortex [and discussion]. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 351, 1413-1420.
- DASTON, L. J., GALISON, P. L. 2010. Objectivity. Zone Books, p. 20
- DUMITRIU, A., (2015) *Trust me I'm an Artist*. [event series] Art Science Ethics [online]. Available at <http://www.artscienceethics.com>
- ESKINE, K. J., KACINIK, N. A. & PRINZ, J. J. 2011. A bad taste in the mouth gustatory disgust influences moral judgment. *Psychological Science*, 22, 295-299.

- FARID, M. (2015). *Seeing I*. [event and documentary] Seeing I [online]. Available at <http://www.seeing-i.co.uk>
- FINCH, J. 1987. The vignette technique in survey research. *Sociology*, 105-114.
- FOOT, P. (1978). *Virtues and vices and other essays in moral philosophy* (pp. 19-32). Berkeley: University of California Press.
- FRANCIS, K. B., HOWARD, C., HOWARD, I., GUMMERUM, M., & GANIS, G. (2015). Moral decision and moral action: Trait Psychopathy and the 'Cynicism' factor in an immersive virtual reality morality scenario. Manuscript submitted for publication.
- FRAYLING, C. 1993. Research in Art and Design [royal College of Art research Papers], 1 (1). *London: Royal College of Art*.
- GIROTTO, V., FERRANTE, D., PIGHIN, S. & GONZALEZ, M. 2007. Postdecisional counterfactual thinking by actors and readers. *Psychological Science*, 18, 510-515.
- GLENBERG, A. M. 2010. Embodiment as a unifying perspective for psychology. *Wiley Interdisciplinary Reviews-Cognitive Science*, 1, 586-596.
- GREENE, J. D., CUSHMAN, F. A., STEWART, L. E., LOWENBERG, K., NYSTROM, L. E. & COHEN, J. D. 2009. Pushing moral buttons: The interaction between personal force and intention in moral judgment. *Cognition*, 111, 364-371.
- HUGHES, R. 1998. Considering the vignette technique and its application to a study of drug injecting and HIV risk and safer behaviour. *Sociology of Health & Illness*, 20, 381-400.
- KALAFAT, J. & GAGLIANO, C. 1996. The use of simulations to assess the impact of an adolescent suicide response curriculum. *Suicide and Life-Threatening Behavior*, 26, 359-364.
- KUPER, A. 2013. *The social science encyclopedia*, Routledge.
- LÖKEN, L. S. & OLAUSSON, H. 2010. The skin as a social organ. *Experimental brain research*, 204, 305-314.
- NAKAMURA, H., ITO, Y., HONMA, Y., MORI, T. & KAWAGUCHI, J. 2014. Cold-hearted or cool-headed: physical coldness promotes utilitarian moral judgment. *Frontiers in psychology*, 5.
- PELHAM, B. & BLANTON, H. 2012. *Conducting research in psychology: Measuring the*

weight of smoke, Cengage Learning.

SCIENCE GALLERY DUBLIN (2011) *Free Will*. [online] Available from: <https://dublin.sciencegallery.com/humanplus/free-will/> [1 September 2015]

SCHNALL, S., HAIDT, J., CLORE, G. L. & JORDAN, A. H. 2008. Disgust as embodied moral judgment. *Personality and social psychology bulletin*.

SIEBER, J. E. & STANLEY, B. 1988. Ethical and professional dimensions of socially sensitive research. *American Psychologist*, 43, 49.

THOMSON, J. T. (1985). The trolley problem. *The Yale Law Journal*, 94, 1395-1415.

URBONAS, J., (2010) *Euthanasia Coaster*. [architectural model and drawings] Julijonas Urbonas [online]. Available at <http://julijonasurbonas.lt/euthanasia-coaster/>

WILSON, T. D., ARONSON, E. & CARLSMITH, K. 2010. The art of laboratory experimentation. *Handbook of social psychology*.

Laughter, *infra-mince* and cybernetics – Exploring the curatorial as creative act

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Abstract

The research project uses an artist's concept; Marcel Duchamp's *infra-mince*, which was developed between 1934 and 1945, as a lens to situate this artist in a wider (art) historical and literary network by suggesting the concept is on the one hand informed by 19th century French society with artists such as the proto-Dadaists Les Fumistes, Alphonse Allais and Alfred Jarry, and with a general importance of subversive humour, laughter and wordplay finding its origin in the work and figure of Rabelais. On the other hand there is an early 20th century French and American context in which scientific proof is put to the test and which allows for a widening via Duchamp's connections to Gertrude Stein with links to Henry James and Hugo Münsterberg as well as the later so-called Oulipo-movement. The reading of the *infra-mince* through this rich historical framework allows for a possible application of this concept within a contemporary curatorial practice of art-science collaborations.

Keywords art-science collaborations, curatorial practice, *infra mince*, laughter, (word)play.

The research investigates the peculiar relation between art and curatorial practice in which it acknowledges the notion of collaboration. It uses the relative novelty of art science collaborations as a paradigm for the produc-

tion, distribution and division of labour within the arts. Throughout the last wider century an important change of competing professional frameworks between artist and curator has taken place. Whereas the latter initially was primarily the custodian of a place, taking care of its reputation and stakeholders via its contents alluding to the etymological origin *curare* – *to care*, she has now evolved into a creative who can be at least as influential as the artist. The parallel situation in which artists and curators now in principle find themselves can either be contested or embraced. One way forward is to recognize laughter as a common ground, as both a disruptive and constitutive force within a creative collaboration. In order to explore this approach the research restores the importance of an artistic concept, Marcel Duchamp's *infra mince*, within the context of curatorial practice, mediation and media archaeology, looking specifically at the role of the speculative, poetic and absurd, the personal and subjective as well as the instant of emergence, in order to gain a better understanding of its possible application in a wider trans-disciplinary context, specifically art-science collaborations.

The research concentrates on the occurrence of a minimal shift or moment of 'transfer from one state to another', alluding to one of *infra mince*'s descriptions given by Duchamp, and uses his work as a lens to understand this minimal shift as proof of an invisible network between actor (e.g. curator, writer or translator) and actants (e.g. art works, space, text or words). By situating Duchamp's concept in a wider art historical and literary context, ranging from proto-Dadaists as François Rabelais, Alfred Jarry, Alphonse Allais, Les Fumistes, Gertrude Stein to the later Oulipo movement; and informed by philosophical and scientific approaches such as pragmatism, cybernetics, diffraction and entanglement, the research forms in the first place a poetic investigation of an invisible force. Where there has been affluent research into the 'non-perceptible' (Henderson, 1998) and 'potential' (Gamboni, 2002), the *infra mince* overall seems to have escaped this attention even though Duchamp's first description is that of it being 'the possible'. Through Duchamp's general interest in (pseudo)science via amongst others Jarry's pataphysics, Henri Poincaré's scepticism and his friendship with the mathematician and cofounder of Oulipo François Le Lionnais, the concept of the *infra mince* also seems to lend itself particularly well for an applica-

tion within an art-science environment.

By concentrating on an individual, subjective and by all means in terms of scale, minimal contribution the research recognizes an approach of art history as suggested by Warburg via an analysis of the instant rather than the evolutionary (Davila, 2010, 25).

The research takes its inspiration further from David Edmonds' and John Eidinow's *Wittgenstein's Poker* (2001) in which a relatively small instant, comparable to the *infra mince* namely the famous altercation between Wittgenstein and Popper, is developed into a wider context.

Research aims

The research aims to contribute to a critical evaluation of current trans-disciplinary collaborations by finding the conceptual roots for a fruitful interaction between art and science in the wider turn of the 19th century and to investigate how these might have resonance for contemporary and future art-science collaborations. It does so by looking into what the artist's (Duchamp's) concept *infra mince* is symptomatic of and what it might 'predict', shedding a particular light on the nature of collaboration, friendship and laughter.

Literature on the *infra mince* over the years slowly but surely augmented, but it can be argued that its full potential still has not been fully analysed and has only partially been applied. The research aims to address these lacunae by connecting to earlier findings by amongst others the poet and critic David Antin (1973), and art historians Michel Sanouillet (1973) and Molly Nesbit (1996). By situating the concept of the *infra mince* in a wider context, amongst others in relation to the writing of Gertrude Stein, a more explicit art-science reading is facilitated. By allocating an important influence to the notion of laughter within a creative practice in both art and science, the research project leads the way to a reflection on everyday (dis)similarities. It situates the speculative and poetic, the personal and subjective in the *infra-mince* because of their inherent contingent nature that is seen as subject to self-regulating principles as described in second-order cybernetics. While the research makes affluent use of references to Duchamp it does not so much intend to be situated within a Duchampian scholarship, but rather

uses an artist's concept to situate it in its time, analyse how it has been informed by its time and how it can have potential wider consequences. For this the research builds amongst others on the ideas of Gilles Deleuze and Gilbert Simondon on individuation (Bryant, 2009) and Michel Serres on the equivalence between literature and science throughout time within a non-linear approach (Serres and Latour, 1995).

The research project further explores the creative and imaginative aspect of curation in the production of meaning. It concentrates on the instant of emergence of creation and does this via an investigation of laughter and friendship, which are acknowledged as both disruptive and constitutive but undervalued elements in the curatorial practice. They are instead within this research seen as essential meaning making faculties within a creative context. Via a thick historiographical research the *infra mince* will be potentially developed as a tool that can be used in the process of curatorial practice, situated at the interface of mutually compatible but conflicting priorities between curator, artists/scientists and audience as well as scientific and/or artistic artefacts. By stressing its faculties as being situated in both the arts and science and notions such as possibility, multiplicity, becoming and transfer as well as its language-based myth-making capacities, the research hopes to introduce a different approach.

Research outputs

The research so far has resulted in an output of several papers, seminars and contributions to conferences.

A first investigation of the terrain explored an immaterial in-between, an interval, as well as the so-called marginal or peripheral as constitutional elements for the curatorial as a creative act. It took four, seemingly unconnected, antagonists as its starting point: Aby Warburg as an important advocate of the iconology of the interval and as curator *avant la lettre*, Alfred Jarry's introducing the idea of paired books, Marcel Duchamp as the inventor of the *infra mince*, and Arthur Koestler for his notion of the bisociative act. Warburg's working method behind his *Mnemosyne Atlas* (and library) was on the one hand contextualised by bringing it into relation

with broader movements of his time such as the trend of the scientific atlas and the collecting of newspaper clippings, whereas on the other hand the linking to more specific insights as Koestler's library angel, Duchamp's use of the *infra-mince* and Jarry's logic of the absurd, tried to define new ways of dealing with the curatorial. In looking for the 'hidden similarities' between these four antagonists this paper preliminarily tried to outline the territory in which further research into the dynamics behind the curatorial process will take place.

A second investigation in the territory of the curatorial as creative act was intended as a thought experiment around the idea of the artist as found system, open-ended and in constant becoming, as an alternative and more flexible solution for the usual art historic conceptualizing of artists. Inspired by René Daumal's *Mount Analogue* and the island of Benoit Mandelbrot it made use of a pataphysical, pragmatist approach, exploring the realm between fiction and reality, and tried to apply Duchamp's *infra-mince* in order to develop a system(atic) thinking about the artist(ic). In questioning the usual framework of art history in which movements are boxed in by being labelled, the essay explored the notion of possibility as being Duchamp's first description of the *infra-mince*, and playful, unusual solutions that point more towards process than finished (art)work.

A third itineration discussed Italo Calvino's text 'Cybernetics and Ghosts' (1967) as a tool for the exploration of the cognitive role of storyteller and reader. Calvino suggests replacing the poet and author by a machine, a suggestion based amongst others on his understanding of the activities of the so-called Oulipo group of which he, like Duchamp, became a member. Founded by writer Raymond Queneau and mathematician François Le Lionnais in 1960, Oulipo or Ouvroir de littérature potentielle (Workroom for potential literature finds its inspiration in Alfred Jarry's '*pataphysics* (with the apostrophe explicitly part of the word). Deceased members are still considered part of the group but are recorded as not available for meetings thus alluding to a process-based approach that overcomes imposed borders such as that between life and death.

The interest in the playful use of language that permeates the research throughout has further been explored in earlier seminars within the context of Transtechnology Research on translation, categories of partial knowledge (with Martyn Woodward), and more recently *The Opaque Lens: Affect and Subversion in Media Practices* (February 2015) which tied together some of the emerging research undertaken within the context of The Temporal Image Research Open Laboratory (TTiROL) by Transtechnology Research. This seminar contextualized the state of ‘opaqueness’ within both poetic and scientific contexts as an affective driver in the very creative act of re-training perception and awareness (Stengers, 2014). A re-reading of the experimental psychologist and poet Gertrude Stein’s so called ‘poetic science’ (as demonstrated within her 1914 text ‘Tender Buttons’), was used as a way of focusing upon language as an affective medium through which perception is re-trained (Lorange, 2014). The seminar positioned itself philosophically through the current wave of affect theory within philosophy and cultural studies via the work of Brian Massumi (2002) and Lisa Blackman (2012) to re-examine the relevance of the historical work of Stein within a twenty-first century context.

Further output consisted of paper presentations at the Deleuze conference in Lisbon (2013) on a wider conceptualization of territory beyond the frame, while a recent contribution to the *Renewable Futures* conference in Riga (2015) investigated Slow/Networked Media Art and the Museum, suggesting that typical Slow Art activities such as gardening and walking matched with a recognition of death and survival through memory as introduced by Rinehart and Ippolito (2014) could be a way forward. The seminar *Ephemeral Affections: Mobile Absolutes (or Absolute Mobiles)* (December 2015) was a continued investigation of ways of reading the world as earlier introduced in the seminar *The Opaque Lens*, opposing scientific measurement to the need for a ‘maximization of friction’ (Whitehead via Stengers) and making mistakes (Duchamp, Bohm) in a quest for and a stimulation of larger imagination.

Overall these kind of outputs endeavour to build a thick meshwork that will enable an original reconnection of the current broad interest in and ubiquity of curation beyond a purely art historical framework into a wider

everyday application, to its provenance and connoisseurship.

References

- Antin, D. (1973). Duchamp and language. In: A. d'Harnoncourt and K. McShine, ed., *Marcel Duchamp*. London: Thames and Hudson, pp.100-115
- Blackman, L. (2012). *Immaterial Bodies: Affect, Embodiment, Mediation*. London: Sage
- Bohm, D. (1994). *Thought as a system*. London: Routledge.
- (1996). *On Creativity*. New York: Routledge.
- Bryant, L. (2009). Individuering. In: E. Romein, M. Schuilenberg and S. Van Tuinen, ed., *Deleuze Compendium*. Amsterdam: Boom, pp.372-387.
- Daumal, R. (1952/2010). *Mount Analogue*. New York: The Overlook Press
- Davila, T. (2010). *De l'inframince*. Paris: Éd. du Regard
- Doove, E. (2011). Exploring the Curatorial as Creative Act: Part I – Hidden Similarities. In M. Punt and M. Blassnigg, ed. *Transtechnology Reader 2011*, Plymouth: Transtechnology Research.
- (2012). Exploring the Curatorial as Creative Act Part II: The Artist as Found System. In M. Punt and M. Blassnigg, ed., *Transtechnology Research Reader 2012-13*, Plymouth: Transtechnology Research.
- (2014). Poet as Machine, on Calvino's Cybernetics and Ghosts. In: M. Punt and M. Blassnigg, ed., *Media Archaeology and Cognition - Transtechnology Research Reader 2014/15*. Plymouth: Transtechnology Research, pp.150-156.
- Henderson, L. (1998). *Duchamp in Context - Science and Technology in The Large Glass and related works*. Princeton: Princeton University Press
- Lorange, A. (2014). *How Reading Is Written – A Brief Index to Gertrude Stein*. Middletown, CT: Wesleyan University Press
- Massumi, B. (2002). *Parables for the Virtual: Movement, Affect, Sensation*. London: Duke University Press
- Molderings, H. (1991). Objects of Modern Scepticism. In: T. De Duve, ed., *The Definitely Unfinished Marcel Duchamp*. Cambridge, Massachusetts: MIT Press, pp.243-65.

Nesbit, M. and Sawelson-Gorse, N. (1996). Concept of Nothing: New Notes by Marcel Duchamp and Walter Arensberg. In: M. Buskirk and Nixon, ed., *The Duchamp Effect*. Massachusetts: MIT and October Magazine, pp.131-175

Poincaré, H. (1905). *Science and hypothesis*. London et al: Walter Scott Publishing Co. Available on www.gutenberg.org/ebooks/37157

Rinehart, R. and Ippolito, J. (2014). *Re-Collection - Art, New Media, and Social Memory*. Cambridge, Massachusetts; London, England: MIT Press.

Sanouillet, M. (1973). Marcel Duchamp and the French intellectual tradition. In: A. d'Harnoncourt and K. McShine, ed., *Marcel Duchamp*, 1st ed. London: Thames and Hudson, pp.48-55

Serres, M. and Latour, B. (1995). *Conversations on science, culture, and time*. Ann Arbor: University of Michigan Press.

Stengers, I. (2008). A Constructivist Reading of Process and Reality. *Theory, Culture & Society*, 25(4), pp.91-110.

Electrophysiology of Cinema Spectatorship

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Abstract

This paper describes the background and preparatory research for an experiment that I will carry out as part of my PhD research into Early Cinema and Cognitive Creativity. With this work I intend to contribute to our understanding of the role of technology in the cinematic experience through forming a bridge between two quite distinct disciplines, that is the historical study of Early Cinema usually conducted within Film Studies communities and the investigation of human perception and cognition as undertaken within many branches of neuroscience.

Scholarly attention within film studies has been focused, naturally enough, on the content of the frame and not the spaces between frames. Film narratives have fascinated theorists as well as audiences and have also caught the attention of experimental psychologists from the pioneering work of Hugo Münsterberg a century ago to recent developments such as Neurocinematics. However, my concern is rather to trace the effect of changing film technologies on the cognitive life of the film spectator. This matters because in 120 years of public film viewing and especially the first twenty years there was a great variety of means by which moving images were produced and projected, the experience of which is not currently historically recoverable. I propose to engage with the diachronic challenge of accurately representing the experience of century old media by employing a combination of experimental media archaeology and techniques of electrophysiology.

An ongoing debate amongst the cinephile community of film professionals and dedicated cinemagoers has centred on the effects of the widespread shift from analogue to digital methods of image capture and exhibition over the last twenty years. In more recent times this debate has shifted from aesthetic concerns of the material differences to the experiential qualities of both systems. However, despite the common binary opposition of analogue and digital, in truth the debate only restates concerns that have always been present about the effect of the technological infrastructure of cinema and its frequent obscuration by much wider debates about the content of film. From my perspective as a practicing film restorer it is important to ensure fidelity to both material and content but in this current work my driving concern is about the misrepresentation of one form of media by another and consequent misinterpretation by audiences.

It is true that this issue may not trouble general audiences. Indeed the brain and visual system is highly adept at inferring meaning from degraded stimuli and it is likely that most viewers simply see through the medium and focus on the content. However we are also able to sense stimuli which are never consciously acknowledged and it is understood that, although we are unaware of it, such information builds and influences our worldview. This points to at least the potential for a barely sensed audiovisual medium to have an effect on the perception and cognition of a viewer and although a generic contemporary audience may not reflect deeply on the means by which it views moving images, for film historians, conservators and curators, working with the remains of 120 years of film exhibition, these are very real problems: The historian wants to know what effect a certain film had on its first public, the conservator with a quasi-Hippocratic duty to 'do no harm' needs to know how their necessary interventions may alter an object and therefore the historical record and curators want to know how to best communicate the essential qualities of a historical film to a contemporary audience. In each case there is the danger of a kind of short-circuiting of history if incorrect decisions or analysis is made, so that what is presented as historical argument, artifact or experience is actually only an ersatz copy or parody. The pioneering work carried out in the 1960s by the likes of Kevin Brownlow (Brownlow, 1968) and George Pratt (Pratt, 1973) which

saved the reputation of Silent films from the slander perpetrated by unsympathetic appropriations is an early example of this desire. What I now wish to add to such work and the subsequent decades' efforts of film preservationists is an understanding of how, despite our best efforts, changes in the technology itself have gone unaccounted for in terms of their potential influence on our experience.

In the collaborative, interdisciplinary environment fostered by the educational programme of CogNovo, I was able to match my interest in better defining the special character of the experience of watching a film and my concern that preservation of that experience, complete with ancillary services and collections, was being neglected, with knowledge gleaned from the science of visual perception. Through consultation with the psychophysicist, William Simpson, I learned that there is considerable evidence in the form of brain wave recordings (Electroencephalograms or EEG) that suggest that the human visual system accommodates its operating frequency to that of the perceived stimulus. These findings, which originate in research carried out by WG Walter in the 1940s and 1950s (Walter, 1953), are accepted as part of the scientific record in the study of visual perception and indeed used widely in clinical applications. However, they are very rarely found in the discourse in film and media studies with which I am familiar through my background in film archiving and restoration. Given that brain rhythms are also thought to be widely responsible for moderating cognition, it therefore follows that a flickering stimulus has the power to alter and direct our cognitive state. (Herrmann, 2001)

The resonance phenomena seen in EEG tests, also called steady-state visual evoked potentials or SSVEPs, can be evoked well beyond even consciously perceived flicker, up to at least 75Hz, suggesting that the entire range of historical through to modern day cinema spectatorship is potentially implicated in the creation of technologically driven brain states. The variety of technological solutions to creating apparent motion extends not only to the speeds of projection (frame rate), shutter design and synchronisation employed but also through hand-cranked and continuously variable motor driven mechanisms which would have created a stimulus of variable fre-

quency. A major difference in the design of digital projectors is the absence of a shutter, the component of analogue film projectors that is primarily responsible for creating flicker, although only as a side effect of the requirement to invisibly pull down the next frame in the filmstrip. The later adoption of standards masks a proliferation of alternative and developing technologies within the early cinema period that are mostly overlooked by the mainstream of media history but which have the potential to richly thicken our understanding of the historical media landscape.

This knowledge has not yet been applied to the extensive scholarship of early cinema and is not even found in discussion in the journal of Society for the Cognitive Study of the Moving Image (SCSMI). More recent interdisciplinary work carried out by film scholars such as those collected together in SCSMI has still assumed film studies' traditional object of study, the film narrative, to be a technologically independent entity. Textual studies have been extended with the application of laboratory techniques to usually mainstream film viewing. This relatively new work is collected under the name of Neurocinematics (Hasson et al., 2008) or Psychocinematics (Shimamura, 2013) but within such studies there is surprisingly little regard for the sheer variety of cinematic technology and its potential for eliciting varied subject responses. Neurocinematics tends to concern itself exclusively with classic mainstream fiction filmmaking and has apparently attracted the attention of film studios, keen to make the art of backing the blockbuster and avoiding the flop more of a science (Randall, 2011). Interestingly enough, in this way it signals a cultural revival of a more or less forgotten history of physiological testing of cinema spectators which Ana Olenina has recently brought to light in her investigation of the work of William Marston, a pupil of Hugo Münsterberg, the Harvard professor often credited with writing the first psychological analysis of cinema (Münsterberg, 1916). Working in the 1920s as a consultant for Paramount and Universal studios, Marston conducted studies which measured blood pressure and respiration changes in subjects watching film scenes selected for their emotional content. (Olenina, 2015)

Employing the knowledge I have gained from the history of EEG testing,

I will also carry out experimental work on film viewers. My investigation will seek to compare the brain response of human subjects, while they view differently mediated projected moving images, produced by historic and modern projection technologies, operating at characteristic but different frequencies. I will compare participants' brain response to projections of analogue and digital versions of the same film stimulus. The intention is to combine experimental media archaeology (Fickers and van den Oever, 2014) – that is media archaeology in which the active use of historic technology is central to the investigation - with electrophysiological techniques.

Archival films from the early cinema period (1895-1915) will be used as stimulus. The content of the images will be the same but the means by which they are delivered will vary. For example, the same content will be delivered via 1) a DCP file through a 2K digital projector; 2) a 35mm film through a modern analogue projector; 3) a 35mm film through a c.1910 hand-cranked projector. In order to control for prior experience, participants will also be asked to complete a questionnaire that will assess their familiarity with viewing (historical) film images and the typical conditions in which they do so. Results from the experiment will be analysed for differences between the different conditions and the SSVEPs which they produce. This will enable me to see if the differences in frequency of stimuli are represented in the evoked potentials, as expected. It will also indicate how these differences relate to the induced, or resting state, potentials which are effectively the brain's default position.

Film studies uses the term *dispositif* to indicate the total environment and agents of an experience, including in the case of the cinema the space of the theatre, the projection technology involved and the eyes and brains of the spectators. It is a useful concept which in recent years has been refined further to encompass the distinct *dispositif* of early cinema (Kessler, 2006), (Parente and de Carvalho, 2008). The proposed amalgamation of the *dispositifs* of theatrical and home cinema with the EEG laboratory may in itself (regardless of outcome) creatively challenge debate. It will also have the effect of forming a curious critique of current neurophysiological investigations of flicker in which testing is carried out using simple stimuli

and modern apparatus which aim to model different real life situations for laboratory enactment rather than engaging with a real object.

As both practical example and philosophical toy, I have obtained an original Butcher's Empire Cinematograph, a typical hand-cranked domestic projector from the 1910s, in order to gain first hand experience with early film technology. I demonstrated this machine to attendees during the Off The Lip conference because I believe it is important to engage fully with the object of research and indeed to give interlocutors the chance to respond to more than a PowerPoint image. (See Figure 1.)

In this case the text of the research is a machine and while it may be studied via the textual analysis of a printed discourse of photographs, patents, sales brochures and the like, interaction with the actual object is most likely to generate original insights.



Figure 1. The author demonstrating the Butcher's Empire Cinematograph Model A during Off The Lip. In the background hangs a poster incorporating a 1920s Pathé publicity image depicting a man hand-cranking a 9.5mm home cinema projector.

of limit case with which to contrast the specification of a modern digital projector, the active experience of its use also provides an interesting source for hypotheses about the nature of flicker in general and how in the case of early and home cinema it was under the control of an operator who was part of the regulatory mechanism. The stimulus was in the hands (literally) and mind of whoever was hand-cranking the projector. The projectionist was also usually in a shared space with other audience members and therefore at the centre of both an individual and collective feedback loop full of affective and creative potential. This situation is imaginatively demonstrated in an image produced by Pathé in order to advertise its 9.5mm home cinema projector about which I have previously written and incorporated into my project poster (see figure 1). This image, which dates from the early 1920s, a time in which Münsterberg had recognized the potential of cinema to mirror mental processes and in which Marston was one of the first to record the physiological responses of cinema spectators, serves to some extent as an inspiration for my experimental design. This project proposal, however, aims to replace the miasma of the thought cloud with the apparatus of scientific instrumentation with the intention that analysis of the experimental data can account for at least a small part of the fog of affect, which constitutes the experience of cinema spectatorship.

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References

Brownlow, K., 1968. *The Parade's gone by...* Secker & Warburg, London.

Fickers, A., van den Oever, A., 2014. *Experimental Media Archaeology: A Plea for New Directions*, in: *Technē/Technology*. Amsterdam University Press, Amsterdam, pp. 272–278.

Hasson, U., Landesman, O., Knappmeyer, B., Vallines, I., Rubin, N., Heeger, D.J., 2008. *Neurocinematics: The Neuroscience of Film*. *Projections* 2, 1–26.

Herrmann, C.S., 2001. Human EEG responses to 1–100 Hz flicker: resonance phe-

nomena in visual cortex and their potential correlation to cognitive phenomena. *Exp. Brain Res.* 137, 346–353.

Kessler, F., 2006. The cinema of attractions as dispositif, in: *The Cinema of Attractions Reloaded*. Amsterdam University Press, pp. 57–69.

Münsterberg, H., 1916. *The Photoplay; a Psychological Study*. D. Appleton and company, New York.

Olenina, A., 2015. The doubly wired spectator: Marston's theory of emotions and psychophysiological research on cinematic pleasure in the 1920s. *Film Hist.* 27, 29–57.

Parente, A., de Carvalho, V., 2008. Cinema as dispositif: Between Cinema and Contemporary Art. *Ciné. Rev. D'études Cinématographiques* 19, 37.

Pratt, G.C., 1973. *Spellbound in darkness: a history of the silent film*. New York Graphic Society, Greenwich, Conn.

Randall, K., 2011. *Rise of Neurocinema: How Hollywood Studios Harness Your Brain-waves to Win Oscars*. Fast Co.

Shimamura, A.P. (Ed.), 2013. *Psychocinematics: Exploring Cognition at the Movies*. Oxford University Press, Oxford ; New York.

Walter, W.G., 1953. *The Living Brain*. Gerald Duckworth & Co., London.

Open State



Adam Benjamin & Dr Mathew Emmett

Introduction

This paper explores the theoretical and technical aspects of *Open State* a Pan Asiatic dance-architecture-music collaboration between Adam Benjamin, Dr Mathew Emmett with technical assistance from Dr Frank Broz.

Venue: Tokyo Art Centre, White Studio.

Choreography & director: Adam Benjamin.

Music & design: Mathew Emmett

Production: Muse Company + Integrated Dance Company-Kyo

Organised by Creative Arts Committee

Grant: Art and Culture Promotion Fund, Arts Council Tokyo & The Great Britain Sasakawa Foundation.

Performance dates: July 19, 20th, 2015.

The general failure to grasp the significance of the many elements that contribute to man's sense of space maybe due to two mistaken notions: (1) that for every effect there is a single and identifiable cause and (2) that man's boundary begins and ends with his skin.

Edward T Hall.

The Hidden Dimension(1969). Doubleday

The Individual Voice

The nascent period prior to the creation of a dance often it takes place internally, a ruminatory period pursued in solitude by the choreographer; a making of space in which ideas, images and voices can emerge and in which the awaited interactions with dancers in real time can, in some ways, be prepared for. The ground is laid for creativity.

Over the past few decades contemporary dance has shifted toward collaborative models of making, in which dancers serve as ‘dance artists’ contributing ideas and movement, rather than mute bodies on which the choreographer scribes his or her ideas.

The process we pursued in this instance allowed the choreographer to engage dancers in the creative process weeks before they met in the studio. The nascent period was in this way shared and owned by dancers and choreographer while their voices were played and played with in virtual space by composer Mathew Emmett.



Improvisation in the House Studio

12.30 GMT watched on Skype by Japanese dancers in Tokyo 8.30pm 9th May 2015



Directions for the Japanese dancers watching UK improvisation

“The dancers in England will be able to hear your voices and see your faces and so the improvisation will be influenced to some extent by your commentary. Sound and silence are both valuable, but it is important that you don’t become completely silent for too long. We will run a number of short improvisations so you will have time to rest and I can give you some feed-back in-between sessions.”



**Directions for
the Japanese dancers
watching
UK improvisation**

Seiichiro Kondo
Asumi Masuda
Maho Amakata



Here watching Ellen Hunn, Adam Benjamin and Kevin French

1. You can describe and comment on what you are seeing
2. You can discuss what you are seeing with each other - perhaps ask each other questions about what is happening.
3. You can speak to the dancers in the improvisation and ask them questions - even though the dancers wont understand or answer
4. You can sometime just watch and say nothing
5. You might even be moved to laughter or to sing a song in response to what you see.

Be natural and don't be afraid to make mistakes (-: We will be altering the sound and quality of your voices when we have the recordings.

6. Enjoy yourselves



Dancers in the studio begin to interact with the 'watching' dancers in Japan. The improvisation moves beyond aural into visual interaction. The dancers begin to form more personal connections.

Compositional Potentials:

The compositional potentials were thus multiple and multifarious

During the making process in Japan, the dancers were on many occasions, listening to their own voices, or treatments of their own voices taken from when they had watched the UK dancers improvising.

Their engagement, investment in the work pre-empts our studio meeting in Tokyo, they (and I) are made aware of our previous meetings, of other dancers, of my world of dance in the UK on which they not only had a window, but which they were able to comment on and interact with. We are all reminded of a longer journey, and a history that leads to this making. We are all thus implicated and enmeshed in the making. There are multiple voices at play here.

The acoustic scores pre-date our short rehearsal period and remind us of a connection to other dancers similarly engaged in creative work on the far side of the globe.

Recordings of the dancers voices were used in a variety of different ways through the use of voice analysis software focusing on time, pitch and intensity.

- Pure data
- Treated voice
- Treated voice mixed with music
- Recognizable voice recordings mixed with music
- We also used live voice during the performance

Each of these forms of recording elicited different presentations and uses generated different acoustic environments in which to work.

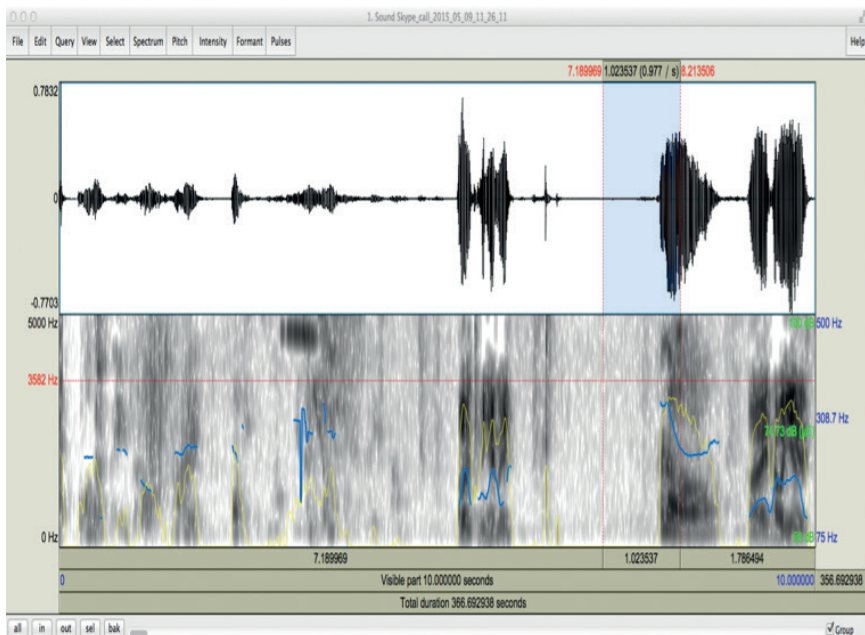
Compositional Potentials: Spectralism

When slowed down and magnified the human voice sounds like a chorus of musical instruments with subtle harmonies with otherworldly – hypnotic timbres.

This transformation ‘scaled-up’ fleeting moments into full scale soundscape. Extracts became incredibly detailed sonic sequences, revealing subtle/hidden spectral granular present in everyday phonetics i.e. they become more perceptible and open to manipulation.

The spectral approach (formulated through computer-based sound analysis) revealed a deep, perspectival sonic world, rich in frequencies, transitory rhythms, tempo and dynamics.

These sounds were treated phenomenologically as a trigger for immersion.



```

time, pitch, intensity
0.01,0,0
0.02,209.461,0
0.03,209.356,0
0.04,212.069,0
0.05,224.832,80.483
0.06,227.735,81.774
0.07,230.424,82.233
0.08,228.739,81.421
0.09,225.172,79.441
0.1,224.377,77.378
0.11,226.206,75.531
0.12,225.19,74.34
0.13,223.435,76.095
0.14,257.919,80.024
0.15,294.779,82.89
0.16,155.495,83.75
0.17,154.338,82.399
0.18,263.128,79.129
0.19,230.453,75.387
0.2,78.236,72.667
0.21,78.2,72.25
0.22,78.822,72.938
0.23,77.188,73.742
0.24,0,77.12
0.25,154.126,80.699
0.26,160.851,82.074
0.27,161.912,81.141
0.28,0,78.183
0.29,0,73.941

```

Dr Frank Broz:

The sound files were processed in Praat, a software tool commonly used by linguists to analyse the phonetics of speech.

A script was written to record the intensity of the sound signal and the frequency of sounds within the human vocal range from sound recordings of the dancers' commentary.

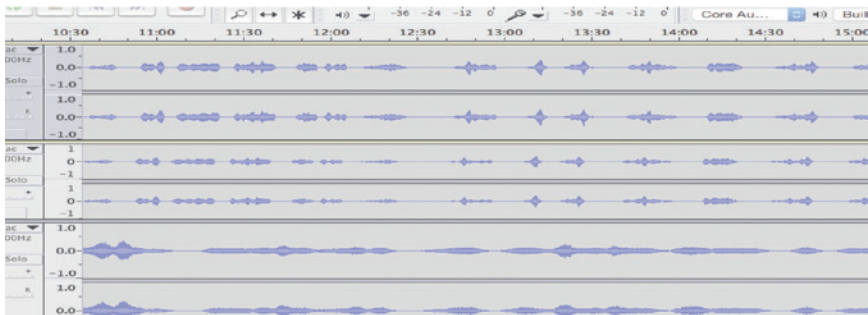
This numeric data about the frequency and intensity of the dancers' voices could then be used as input data to compose new sounds based on the qualities of their speech.

Compositional Potentials: Spectralism

Slowing down the sound gave the dancers and audience more time to reflect on the development of the piece – suggesting a more internal element to the choreographer and prompting him to make ‘other’ choices with the dancers that differed from his usual spectrum.

The elemental symbolism of unifying forces is carried by the vehicle of the slow motion – recalling the liminal state of being immersed within the breath.

The breath features as a reflective medium – suspending the performers and audience in a liminal space, drawing attention to the unchanging need to breathe.

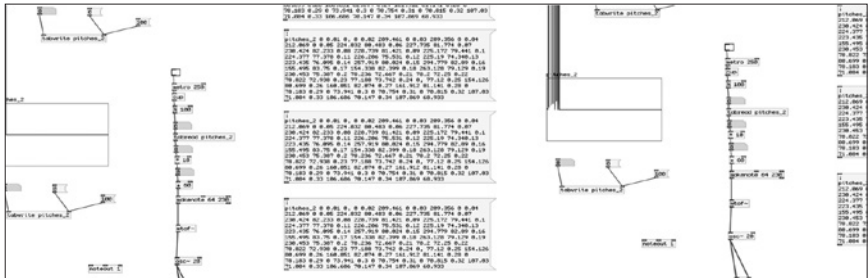


Compositional Potentials: Spectralism

Open State developed the spectral approach to acoustic-composition by concentrating exclusively on one small sequence of the voice and by magnifying these notes an entire universe of overtones fills the surrounding space.

By foregrounding the timbre and envelope, the soundscape was designed to include transitory aspects through intonation – sliding the pitch up and down perpendicular to the central position (glissando) directing the attention to the spectral sum of overtones and texture.

A duality of identity and non-identity emerges creating micro-tonalities - where a single tone is both an individual entity but also the conveying medium for the whole – creating a complete field (or Ganzfeld in German) that inhales you.



Pure Data Patch by Mathew Emmett.



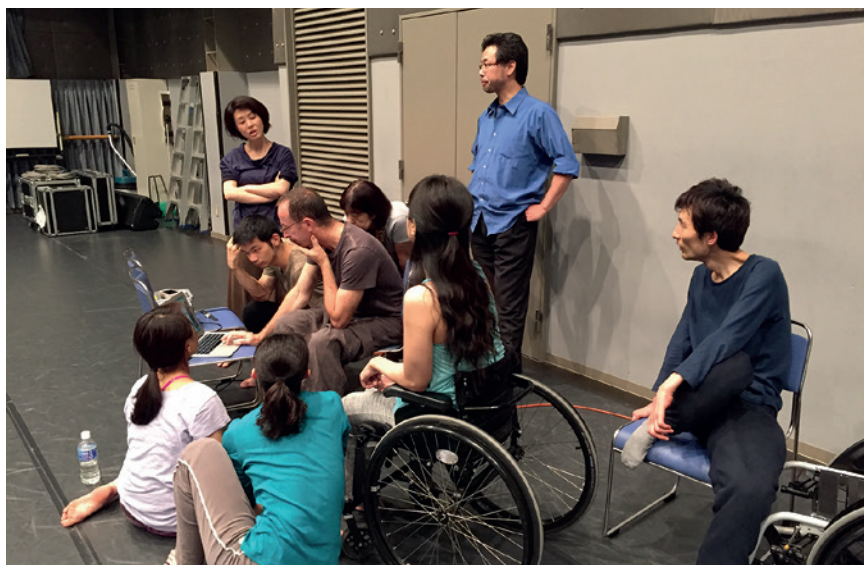
Improvisation in the Saison Studio Tokyo

19.30 watched on Skype by dancers in Plymouth 12.30 GMT
30th June 2015

These sessions of recordings harvested the material for the development of the second part of the project that will be a piece made in the UK with UK based dancers utilizing the voice recordings from observing the Japanese dancers.



Skype session in Tokyo with UK dancers on screen



Adam with dancers and dance critic Takao Norikoshi during Skype session with UK.

Integrated Dance Company
 響 Kyo
 Premier their new work
Open State
 Choreographed by Adam Benjamin
 Tokyo Arts Centre, Kita-Senju
 July, Sunday 19th, 6pm and Monday 20th, 3pm

Tickets on the door or from: musekk@aol.com

主催: クリエイティブ・アート実行委員会 助成: 芸術文化振興基金 アーツカウンシル東京(公益財団法人東京都歴史文化財団)
 問い合わせ先: クリエイティブ・アート実行委員会 (事務局: ミューズカンパニー) 〒107-0052 東京都港区赤坂 6-2-5-201 電話03-6426-5182 Fax03-6426-5183 e-mail: Musekk@aol.com HP: <http://www.musekk.co.jp>



Pure data composed by Mathew Emmett.



Prepared voice by Mathew Emmett + treated voice with live spoken text.



Prepared voice by Mathew Emmett mixed with looped edit of 'Burning Mouth' by John Matthias



Prepared voice by Mathew Emmett mixed with looped version of 'Rotate' by John Matthias



Recognizable voice recordings from Skype mixed with music [GoGo Penguin]

**Post performance
talk with Takao
Norikoshi** 19th July 2015

[Feed-back forms are being
translated]





“I could actually feel this time during the rehearsals that the bond, the connection with other dancers became deeper and deeper as the more time we spent together. And I started feeling more responsible that I ought to be involved more in this kind of activities to let more people know that this kind of ‘world’ exists.”

Seichiro Kondo – disabled Japanese dancer

“I wish disabled people feel more confident to try new challenges and I would like to be the good role model for this to happen. It was refreshing to experience the unique movement of disabled dancers in wheelchairs especially when we dance with abled body dancers. I felt as if we were offering additional spice to the dance piece. As a member of Kyo it is important to let many people know that disabled dancers like us exist and offer opportunities for not just those who are interested in dance but also for general public to watch integrated dance.

I do hope wheelchair dancers will be accepted as a form of new dance in the future, and there will be more dance companies like Kyo in Japan.”

Yoko Izumi – disabled Japanese dancer



Evidence on-line

Two earlier articles appeared in the Japanese national press.

sankei.com/entertainments/news/150712/ent1507120014-n1.html

<http://www.sankei.com/entertainments/news/150712/ent1507120015-n1.html>

extensive tweeter and Facebook coverage:

<https://twitter.com/KyodayoKyo/media>

tweeter from the dance critic Takao Nori

<http://www.nori54.com>

Audience Numbers at Tokyo Arts Centre:

19th July 2015: 85

20th July 2015: 91

The Review in the Sankei Shinbun Newspaper:
<http://www.sankei.com/entertainments/news/150726/ent1507260012-n1.html>

[Excerpts] highly skilled physical control and great trust between the dancers leads us through a series of playful choreography into the most unexpected surprises. The smooth movement of the wheelchairs, their speed and turns expands the stage and brings surprising new possibilities to the ensemble

the wheelchair was there on the stage not as a special tool but as a part of the body or a new costume and enriched the dancers' expression even deeper.

The piece conveys the idea that we are all unique, allowing us to appreciate the strength and unknown beauty of difference.

Sae Okami – Dance Critique



Findings

- The integration of dancers in the conceptual framework [prior to studio making].
 - The building of creative relationships between Japan and the UK.
 - The use of voice as an international medium for exploration.
 - The establishment of the first professional integrated dance company in Japan.
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- The planning of the second phase of the project based in the UK which reciprocates and evolves the research.



From Conceptual Blending to Procedural Blending: Applying a Model of Cognition to Process in Sound Art Practice

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Abstract

This paper is based on a practice-led PhD research project conducted at CRiSAP, University of the Arts London. In this research, a theory of cognition, *conceptual blending* (Fauconnier and Turner 2003), was applied to the investigation of process in sound art practice, resulting in the model of *procedural blending* (Garrelfs 2015).

Conceptual blending posits that everyday, subconscious activities such as cross-domain mapping are involved in combining elements from a range of inputs into new concepts. Procedural blending borrows from and extends conceptual blending to create a tool for considering and articulating process, allowing artists to foreground their own voices within discourse.

Through the notion of inputs, which are blended through an iterative process of making into outputs, procedural blending illustrates how new work is created. Inputs can be drawn from diverse, even dissimilar categories, including media, genres, technologies, approaches, and even personal aspects such as emotions or personality traits can be considered as an input. As a consequence, this research also extends the notion of process to include all that artists might encounter in their lives.

This paper is divided into two parts: The first part introduces the key principles of the original theory of conceptual blending, followed by the adapted model of procedural blending and an illustration based on one of the author's own creative projects, a set of eight compositions released on the CD *Bedroom Symphonies* (Garrelfs 2014). This illustration will also serve to demonstrate blending as a tool for articulating practice. The second part will suggest potential additional applications of the principles of blending, which include a method for creating works, collaborations, capturing process and analysing works and concepts.

Keywords conceptual blending, procedural blending, sound art, process, creative practice

Introduction

Sound art is “explicitly intermedia”, states musicologist Barbara Barthelmes (2006:44), and for a sound art practitioner such as myself it can be a challenging yet crucial task to make sense of and to communicate a potentially broad range of activities succinctly; in my case, practice take place at the cusp of music, fine art and sociology and spans installation, improvised performance and fixed media works (figures 1 and 2).

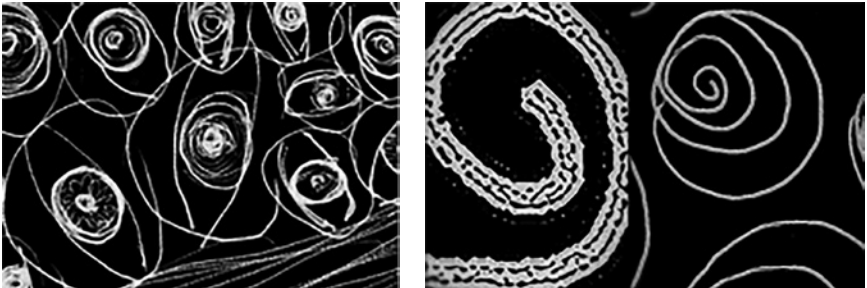
Procedural blending (Garrelfs 2015) was primarily developed as a tool for artists to discern commonalities within difference and to communicate complexity. It borrows and extends concepts from *conceptual blending*, a theory of cognition developed by Gilles Fauconnier and Mark Turner (2003). As part of a practice-led PhD project conducted at University of the Arts between 2010 and 2014, this theory was applied to sound arts process through a series of specifically designed creative projects, a set of collaborative workshops, interviews and commissioned articles¹.

¹ The articles are published as part of an online journal, available from <http://www.reflections-on-process-in-sound.net>. The interviews will be published in book format at a later stage.



Figure 1. Improvised performance responding to textual and graphical “scores” made by the audience during a keynote performance lecture by the artist at Field Studies, Musarc, The Cass Faculty of Art, Architecture and Design, London Metropolitan University in 2015. Copyright: Joseph Koblmaier

This paper is divided into two parts: The first part introduces the key principles of the original theory of conceptual blending, followed by my adapted model of procedural blending and an illustration based on one of my own projects, a set of eight compositions released on the CD *Bedroom Symphonies* (Garrelfs 2014). This illustration will also serve to demonstrate blending as a tool to explore and communicate practice. The second part of this paper will introduce potential additional applications of the principles of blending: a method for creating works, collaborations, capturing process and analysing works and concepts. These are covered to varying degrees.



*Figure 2. Series of screenshots from the audio-visual installation *Traces in/of/with Sound*, shown at *NOISE* and *Whispers*, GV Art, in 2013*

1 From conceptual blending to procedural blending

As a theory of cognition, conceptual blending models how concepts are developed in the human mind, how human beings make sense of the world by reducing complexity to more understandable dimensions. At its heart lies the notion that as part of everyday, subconscious mental activities, people select *elements* from a range of *inputs*, which are held within a *generic space*, and connected into a *blend* (see figure 3). Through the blending of elements something new comes into being and the “blend develops emergent structure that is not in the inputs” (Fauconnier & Turner 2003:42). Once in place it can, but does not have to, manifest as a *material anchor*, that is as a physical manifestation of ideas (Fauconnier & Turner 2003:195).

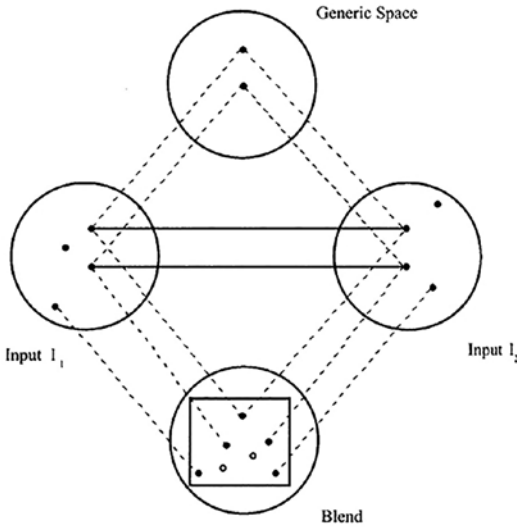


Figure 3. Blend diagram according to Fauconnier & Turner (2003:46)

In conceptual blending, blends can become very complex and inputs can be recruited from a diverse range of categories:

Varieties of meaning that on their faces seemed unequal – such as categorizations, analogies, counterfactuals, metaphors, rituals, scientific notions, mathematical proofs, and grammatical constructions – turn out to be avatars of the spirit of blending. (Fauconnier & Turner 2003:106)

The notion that blends employ very different types of inputs resonates with a creative practice that embraces, for instance, different media (film, sound recording), formats (performance, installation), methods (improvisation, collaging), and sensorial experiences (listening, watching). However, whilst conceptual blending addresses subconscious cognition and the formation of concepts, the creation of sound art is an iterative process that also incorporates conscious responses and physical aspects of making. Procedural blending, therefore, takes some of the key concepts of conceptual blending as a point of departure to offer a model of process through which practice can be explored and communicated from the artist's perspective.

In procedural blending, elements from a range of inputs are combined into an output. Each of these inputs can be drawn from a wide variety of categories, from concepts or commission briefs to tools or physical interactions; everything that flows into practice can become an input. In principle, therefore, the notion of an input equalises the *value* of all potential inputs, although in practice each artist establishes their own selections from the available inputs. In viewing inputs as flexible temporal containers, the system of procedural blending becomes scalable and allows the focus to settle on any aspect of practice, at any granularity, applying the same principles and terminology.

As with conceptual blending, procedural blending *inputs* are made up of *elements*, some of which are selected, whilst others are not. As procedural blending is scalable, at a different resolution an element can be viewed as an input in its own right. For example, the input of sound art contains the elements of installation and performance. Re-scaled from element to input, the category of installation may contain the elements of site-specificity and interactivity. To avoid confusion arising from such re-scaling, procedural blending primarily focuses on the notion of the input to discuss any given work.

Once selected, elements (inputs) are combined as part of a *blend node*; it is the point at which conscious and subconscious decisions are made and con-

nection are established. These decisions are influenced by *blend lenses*, a still unrefined container term which describes a view or indeed any factor that influences the selection of and from inputs. These may include the restraints that using a specific software or a commission brief entail just as it does cultural world views, personal childhood experiences or emotions.

As an iterative activity, procedural blending introduces *blend lines* as temporal trajectories of making. For instance, to develop an audio-visual work, the sonic and visual aspects may be worked on separately for some time, in which case each can be regarded as a blend line, as was done in the example of *Bedroom Symphonies* below. Viewed as a system, the term *blend field* designates an interconnected network of blends and blend lines created in the development of a piece. The outcome of an instance of process is called an *output*. This may be an artwork, a realisation that carries on as an input to subsequent works, or a theoretical text. Figure 4 depicts these concepts and their potential relationships as a flowchart, as a blend diagram of process. I will use such a diagram later when illustrating procedural blending by applying it to *Bedroom Symphonies*.

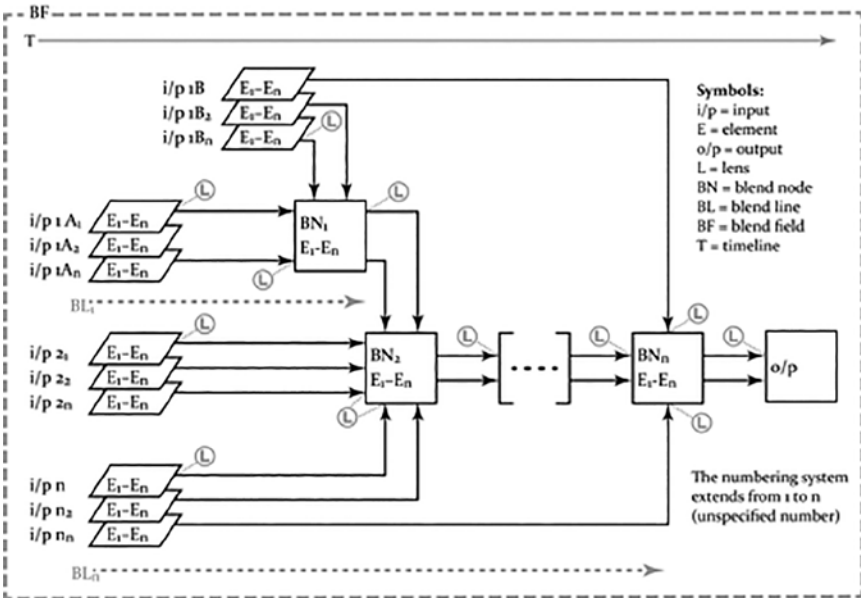


Figure 4. A graphical model of procedural blending in sound art practice (blend diagram)

a set of inputs we select elements affected by lenses (L), resolving themselves within a blend node (BN1). Each choice may be affected by more than one lens. Several trajectories or blend lines (BL) may be involved (BN2). The whole system constitutes a blend field (BF) although we might also examine smaller subsections as such. At any point, new inputs may be added or dropped, or we might re-consider those previously discarded. These steps may be repeated several times, yielding any number of outputs, although the model depicts only one. Whilst input, element and output are notions retained from conceptual blending, the terms of blend node, blend lens, blend line and blend field are adaptations or newly introduced concepts. Some concepts from conceptual blending, for example the notion of a *frame*, were not used in procedural blending.

Procedural blending was developed to aid sound artists in examining and communicating their practice, especially when it is as diverse and complex as in my case. By way of illustrating the concepts introduced so far I will now apply them to one of my projects, *Bedroom Symphonies* (Garrelfs 2014).

Bedroom Symphonies is an album containing eight stereo compositions made from hotel-room voice practice sessions during a number of tours and residencies between 2006 and 2009. The initial process is described in the accompanying booklet as follows:

So, imagine me sitting on a bed, laptop on the night table with my trusted cheap head mic plugged straight into it and you won't be too far from reality.

As the mic isn't exactly the best on the market and it's also done sans soundcard, there is a certain raw feel to the sound – and I have tended to whack up the effects in places. I really like the way you can hear the materiality of the situation in the recording! The result is a rather curious, private piece, a performance entirely without an audience. (Garrelfs 2014:3)

The pieces were composed by collaging this audio material in 2014. The

album is accompanied by a booklet containing photographs from the journeys and a critical review of my work by Brandon LaBelle. The album is available as a digital download and as a limited edition physical CD that includes two small photographic prints (figure 5). The brochure is hosted on a digital platform.

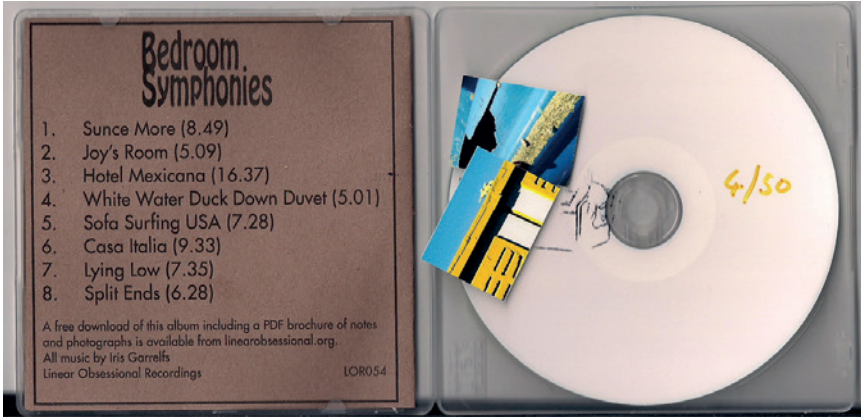


Figure 5. Image showing the CD *Bedroom Symphonies*, including two photographic prints

Viewed as a blend field (figure 6), *Bedroom Symphonies* can be broken down into two simple blend lines, with two respective connecting outputs. Blend line 1 takes input 1 (a series of practice recordings) to a selection stage and a composing stage through to the CD. Blend line 2 takes a series of photographs through comparable stages, and adds LaBelle's essay about my work to the final brochure. Both blend lines come together in the output, which is made up of several parts, a physical limited edition CD with two small-size photographic prints, an online release, and an online brochure. The initial decision to create the CD and its title relate to both blend lines.

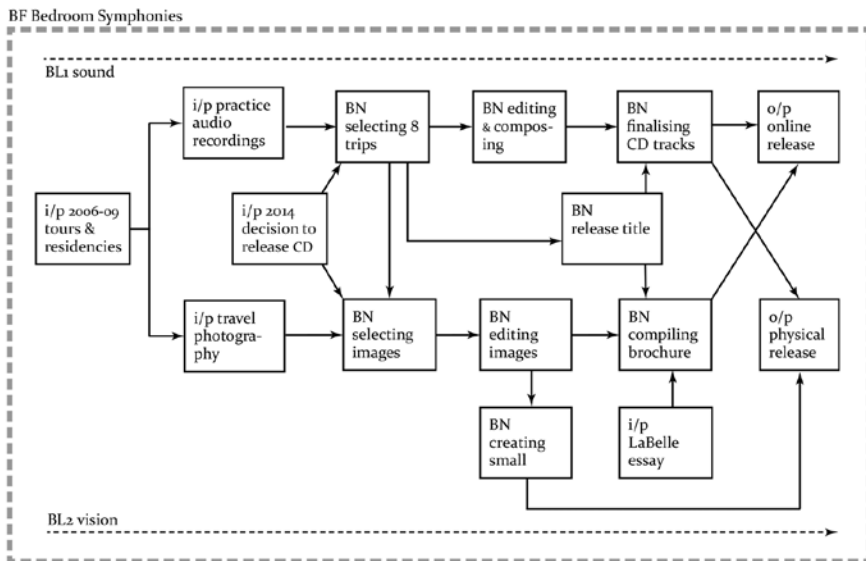


Figure 6. Blend diagram for Bedroom Symphonies

To illustrate the principles of procedural blending the above description of process examines *Bedroom Symphonies* at a relatively large resolution. However, the same concepts can be used to explore practice in more detail. This is achieved by “zooming” into an input and its elements until a more detailed picture emerges, and one input is revealed as an interconnected blend field in its own right. For example, the input of “practice recordings” in BL1 might be examined more closely by investigating the tools that were used there (I have mentioned some of them in the above quotation from the CD brochure). I could also have explored exactly how each individual journey is reflected in the work. In this way, procedural blending articulates process for a specific purpose.

2 Further potential applications of the principles of blending

In addition to exploring and communicating process from an artist’s perspective, further uses of procedural blending principles suggest themselves. These include supporting the creation of new works, facilitating collaborations, capturing on-going process and analysing works or concepts. They are

covered here in the order they are mentioned, although to varying degrees.

The first additional application is a method aiding the creation of new work. Artists frequently find themselves in situations where they need to respond to commission briefs and may find inspiration slow to arrive. This method can help to overcome such difficulties, even if it is not applied fully; the underlying principle here is the generation of inputs and their elements until some of them connect (see figure 7). From each input, an indefinite amount (n) of associations are generated, each of which may yield an equally unspecified amount of sub-associations. Process connects a finite selection, leading to an output.

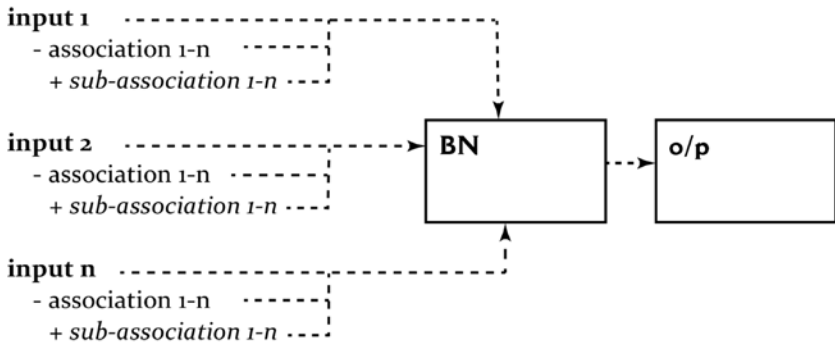


Figure 7. Diagram illustrating the principle of how blending might be used as a method for creating work

record and explore individual topics and factors such as a commission brief as inputs, to which new associations are added as needed. Any association may add a new idea to this list of potential inputs. A 'flip-side' approach, in which the opposite of an initial idea is explored, can also be used to generate new inputs.² Mappings may illuminate familiar inputs by looking at one input in terms of another. As an additional feature, one might introduce surprising and, apparently, completely unrelated ideas to the system, with the aim of exploring potential connections and thereby opening new

² Interestingly, I recently encountered an experimental mathematician, who also described this technique.

perspectives and understandings. To illustrate this I have constructed a hypothetical brief which calls for a site-specific recording based on the location of London's Elephant & Castle (see figure 8).

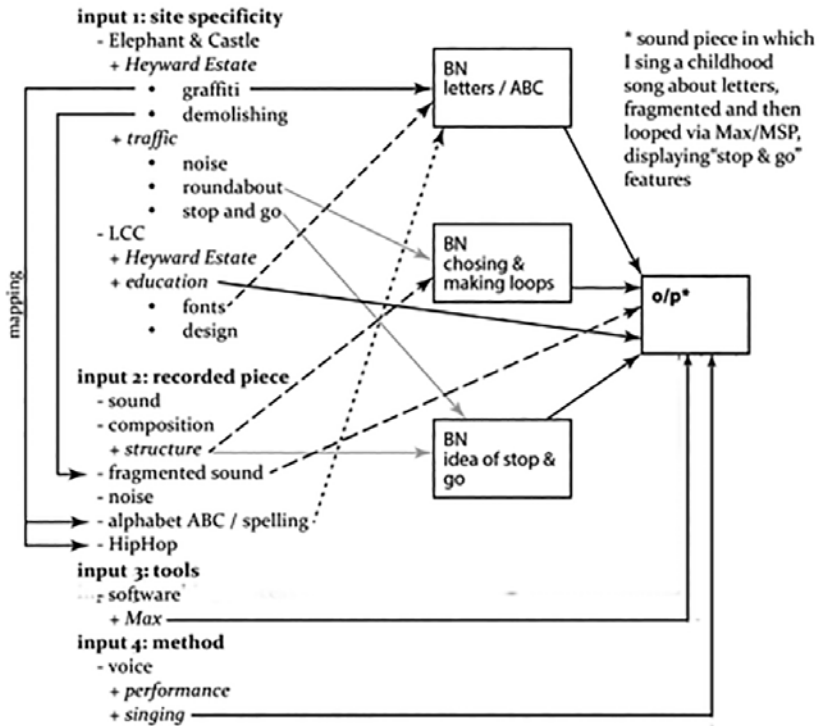


Figure 8. An example of how blending can be used as a method for creating work

Input 1 relates to the site-specific³ aspects and input 2 represents the specification that a recorded piece should be produced. I added input 3 for tools and input 4 for methods. As a second step I generated several associations and sub-associations; some came about through mapping. For instance, applying the idea of *demolition* to *recorded piece* generated an association of

³ LCC stands for London College of Communication, which used to be London College of Printing. The Heyward Estate was left empty for a considerable period of time, attracting graffiti artists, and has now been demolished.

fragmented sound.

For the blend, only some of the generated ideas were selected. This resulted in a hypothetical piece in which I would sing (selected from input 4 *method*) a childhood song (applying *method* to a sub-association in input 1 *education*) which is designed to teach children the *ABC* (mapping *graffiti* in input 1 onto *recorded piece* in input 2, merged with teaching *font* production in *education* to arrive at *alphabet* and the *ABC*), and which in turn is fragmented by a software process in *Max⁴* (input 3, tools), arranged using loops (an idea derived from applying an association in input 1 *roundabout* to input 4 *method*). The overall *structure* (input 2) is derived from the *stop and go* traffic flow (input 1), meaning that the loops should be used intermittently. In “real life”, the success of each achieved blend would be evaluated and decisions would be taken whether to develop resulting ideas further or not.

Thinking about practice in this way may be useful to artists, and perhaps particularly students, as it makes explicit potential routes by which connections between various parameters of work can be forged, with the potential ultimately to assist the creator in deepening and extending connections across wider areas of their practice.

As we ponder the widening connections between different aspects of individual process, the same principles can also facilitate connections between different people; interdisciplinary collaborations, be that for the purpose of creating art works or for research, may prove particularly difficult, especially where concepts differ widely. Such collaborations may therefore benefit from a tool such as procedural blending (see figure 9).

To begin with, we may understand each discipline or participating collaborator as a blend field, each of which will have key inputs that need to be reflected in the output. Less important inputs will also be present although they might not have to find correspondence in the output at all, or at last

⁴ Max is a digital signal processing environment developed by Cycling 74.

not to the same extent. Each input is made up of a set of elements, some of which may also be more important than others. Making such aspects explicit may enable connections between even very diverse subjects to become visible. We can “drill” into each input or element as deeply as needed until connections are established. Joint evaluation stages are important where participants can comment on the value of achieved connections (blends), from individual perspectives as well as joint goal-oriented viewpoints. At any stage, difficulties arising from the process can be recruited as explicit inputs to the process. “Random” elements could also be introduced; in attempting to connect these with existing inputs, new routes to understanding may be opened.

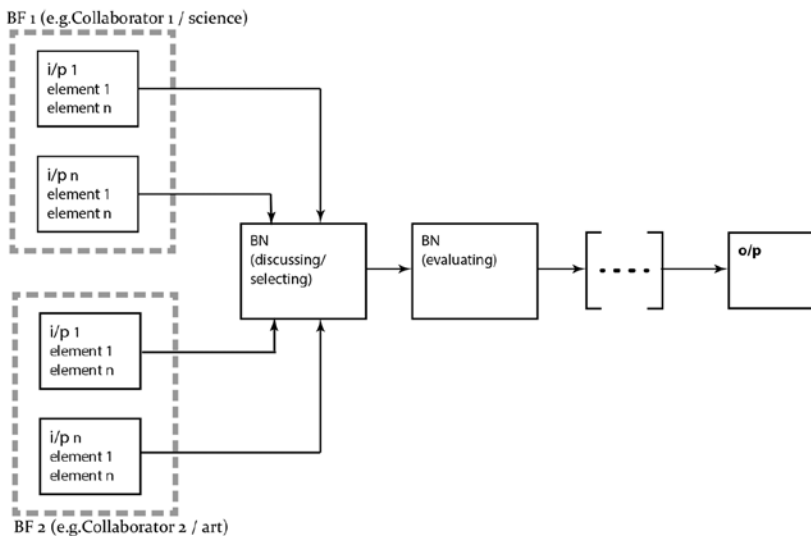


Figure 9. Blending in collaborations

Up to this point I have explored how the principles of procedural blending can aid the process of making; this last section will suggest blending as a means for capturing process and for analysis.

As part of the cross-university research group Collaboration for Research Enhancement by Active Metadata (CREAM),⁵ I have recently introduced

procedural blending for capturing the developmental data of two new audio-visual works, *Smoke* and *Fog*. Using the linked data notebook Annalist,⁶ a software tool by Graham Klyne of Nine by Nine still in its developmental phase, I recorded activities on the basis of the model's principles, noting inputs, decision points (blend nodes), blend lines and, of course, outputs. Respective blend diagrams were designed manually (see figure 10), although at some point it may be possible to extract at least some features automatically. In capturing process through blending, some analogies with provenance and workflow capture became visible.

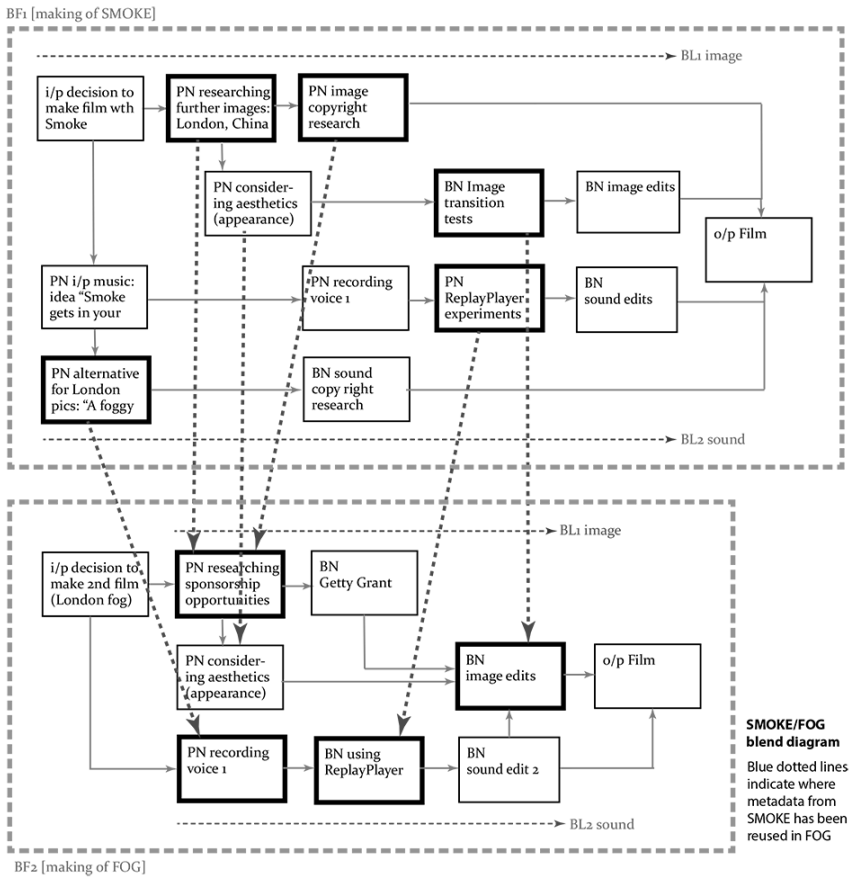


Figure 10: A blend diagram at a low granularity correlating the making of two audio-visual works, *Smoke* and *Fog*, indicating where metadata was re-used

After introducing procedural blending as a tool for discussing process, for creating work, for collaborating and for capturing process, it also suggests itself as a framework for analysing artworks and probing into the meanings of categories. With respect to the original model of conceptual blending, linguist Charles Forceville has already noted its potential for the analysis of multimodal works (Forceville 2004), with a relatively low take-up rate to date, some from the field of music (cf. (Zbikowski 2008, Fatihi 2012)). Using procedural blending as a framework for such an analysis may make this task a little easier.

Lastly, the notion of inputs enables the exploration of potentially very diverse understandings of individual categories, by comparing and contrasting the elements and sub-elements contained in each. As relational and context-dependent constructs, they aid the making of connections between subjective perspectives across cultural times and locations (cf. Garrelfs 2015:105). As a simplistic example, looking at the input of music, do I require music to be harmonic or am I attracted by dissonances and machine noises, as was the Futurist Luigi Russolo (1986) and many others?

Conclusion

In this paper I introduced procedural blending (Garrelfs 2015) as a model of process in sound art practice. It was adapted and extended from the model of conceptual blending, a theory of cognition (Fauconnier & Turner 2003).

In summary, procedural blending is intended as a tool for practitioners that aids the consideration and articulation of practice. It describes a journey of process in which artists select elements from a range of inputs, which are then connected to create one or more outputs. Inputs can be everything that flows into practice, from concepts, tools and commission briefs to personal concerns, methods or physical interactions. As a result, the no-

⁵ <https://blog.soton.ac.uk/cream>

⁶ <https://github.com/gklyne/annalist>

tion of process is also extended potentially to include all that artists might encounter in their lives. Elements are selected consciously or subconsciously, influenced by blend lenses. These may be internal lenses such as likes or dislikes, or external lenses such as commission briefs. Selected elements are then connected to each other within a blend node. A series of subsequent blends is called a blend line, an interconnected network of blends and blend lines a blend field.

These concepts are useful to me as a practitioner in a number of ways. Firstly, they are scalable, meaning that they can be applied to any aspect of practice, at any degree of granularity. Interrogating practice from a range of such perspectives then allows me to communicate both process and outcomes using one strategy, into which any other approach can be embedded as a further input. As an example, I may choose to explore psychological concepts to question the potential input of a childhood experience. When bringing all considerations together I can achieve this through the framework of procedural blending.

Furthermore, the same principles can also be used as a framework that directly aids the creation of work, rather than just articulating its creation; they can assist collaborative efforts by making participants' key concerns explicit and methodically aiding connections to be implemented; they can underpin the capturing of process and support the analysis of artworks or concepts. That said, as a tool and model it is in its infancy, with scope for further refinement in all the aspects discussed here.

Lastly, I would like to warn against over-simplifications, as no isolated aspect of practice can be used to explain its complexity fully. Rather, I would like to echo a comment by art historian Griselda Pollock, made in response to research where algorithms were used to analyse and compare paintings:

To study art history, we need to know about economics, politics, literature, philosophy, languages, theologies, ideologies while also studying to understand how art thinks. Art thinks through making, through forms, through materials. And over the past century, art history has

been enriched by feminist, post-colonial, queer, and trans-national perspectives. (Pollock 2014)

As “art thinks through making”, procedural blending seeks to be a tool that aids artists in articulating their process of making, allowing us to insert our perspectives into the discussion and to foreground our voices within this complex and constantly shifting discourse.

Acknowledgements

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References

- Barthelmes, Barbara (2006). Sound art in musicological discourse. In: *Sound art: zwischen avantgarde und popkultur*, eds. Anne Thurmann-Jajes & Sabine Breitsameter & Winfried Pauleit. Schriftenreihe für Künstlerpublikationen Vol. 3. Köln: Salon-Verlag
- Fatihi, A.R. (2012). Conceptual blending in Bollywood film songs. In: *South Asian Cultural Studies* 4(1), pp. 19-26
- Fauconnier, Gilles & Turner, Mark (2002). *The way we think: conceptual blending and the mind's hidden complexities*. New York, NY: Basic Books
- Forceville, Charles (2004). Review of Fauconnier and Turner (2002). In: *Metaphor and Symbol* 19(1), pp. 83-89
- Garrelfs, Iris (2014). *Bedroom Symphonies*. CD release with accompanying booklet on Linear Obsessional. Available from <http://linearobsessional.bandcamp.com/album/bedroom-symphonies>
- Garrelfs, Iris (2015). *From inputs to outputs: an investigation of process in sound art practice*. PhD thesis, CRISAP, London College of Communication, University of the Arts London. Available from <http://irisgarrelfs.com/thesis>

Pollock, Griselda (2014). Computers can find similarities between paintings – but art history is about so much more. In: *The Conversation* (online). Available from <http://the-conversation.com/computers-can-find-similarities-between-paintings-but-art-history-is-about-so-much-more-30752>

Russolo, Luigi (1986). *The art of noises*. Monographs in Musicology No.6. Translated from the Italian by Barclay Brown. New York, NY: Pendragon Press. First published in 1913

Zbikowski, Lawrence M (2009). Music, language, and multimodal metaphor. In: *Multimodal metaphor*, eds. Charles Forceville and Eduardo Urios-Aparisi. Berlin: Mouton de Gruyter

N,N-Dimethyltryptamine: An endogenous neurotransmitter with extraordinary effects.

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*In memoriam of Dr. Martha Blassnigg (*08.09.1969; †27.09.2015) who went home much too soon.*

Abstract

The most complex physical object in the known universe is the human brain and the most complex mental phenomenon is the human psyche. Humanity has travelled through outer space and we now possess detailed charts of the moon and many other extraterrestrial objects. However, hitherto modern science is unable to provide a comprehensive cartography of the varieties of human experience (Fisher, 1971), despite the efforts of the extraordinary Swiss depth psychologist Carl Gustav Jung who provided a rudimentary “skeletal” map of the psyche. Ergo, the great frontiers of 21st century science are internal and psychological and it should be psychology’s primary focus to systematically chart these largely unexplored “antipodes of mind” – the “terra incognita” – as Aldous Huxley eloquently formulated it (Huxley, 1956, p.71). In this context, it has been effectively argued that the discovery of several unique psychoactive chemical substances is methodologically as important to the study of the mind as the invention of the microscope to progress in chemistry or the telescope to astronomy (Grof, 2000, p.297). This paper reviews a powerful endogenous psychoactive agent, N,N-Dimethyltryptamine (DMT, a structural analog of serotonin and melatonin), which catalyses unique and highly astonishing phenomenological experiences. An eclectic, interdisciplinary approach is adopted and DMT’s pertinence for systematic research in psychology and neuroscience is discussed.

Keywords N,N-Dimethyltryptamine, 5-hydroxytryptamine, phytochemistry, cognition, perception, neuroscience, psychology.

Introduction

What is mind? No matter.

What is matter? Never mind.

—George Berkeley (1685-1753)

In this classic couplet, Bishop Berkeley concisely addressed the quintessential philosophical question concerning the fundamental relationship between mind and matter (note that he employs Cartesian dualistic terminology; i.e., *res extensa* vs. *res cogitans*).

The question Berkeley poses is the following: Can mind/consciousness ultimately be explained in a purely materialistic framework (is “it” reducible to neurobiological mechanisms, molecules, atoms, etc. pp.)? Vice versa, the quote addresses the inverse question: Can the totality of physical reality (in Lockean nomenclature, the entirety of “primary and secondary qualities”) be accounted for solely in terms of mind? In other terms, is the material world an idealistic creation of the mind, as many ancient eastern metaphysical wisdom traditions postulate (experience, then, is the sole reality and the observer/subject and the observed/object are of identical nature; e.g., *Bhagavad Gītā*, *Vedānta*, *Rigvedas*, *Yoga Sūtras* of Patañjali)? This paradoxical conundrum is a deep-rooted perennial problem in the philosophy of mind and it has recently become a topic of interest for many neuroscientists.

Neurochemistry of cognition

Contemporary materialistic reductionist neuroscience emanates from the provisional working hypothesis that the underpinnings of human cognition, perception, and consciousness are electrochemical. That is, electrical action potentials and chemical neurotransmission are hypothesized to ontologically cause these phenomena. However, it is possible that this unproven assumption might eventually turn out to be a case of epistemological naiveté. Nevertheless, it is an established scientific fact that there are certain classes

of material substances that affect consciousness reliably (the terms consciousness and mind are consequently used synonymously). However, not any arbitrary substance can alter the mind. The mind-altering substances in question have precisely defined molecular structures, which in turn cause very specific effects. For instance, there are certain psychoactive substances that induce sedation (for instance, Diazepam). This particular sedative is a specific case of a much larger chemical class (i.e., the Benzodiazepine family). Thus, there appears to be a systematic correlation between the chemical structure of certain compounds and the psychological effects they induce (in psychopharmacology this is known as the structure-activity relationship). Interestingly, especially from a neurochemistry/biology point of view, several naturally occurring secondary (possibly semiotic) plant compounds have close structural relationships with various mammalian (including human) neurotransmitters and can consequently bind to specific cell membrane receptors in the brain. Thereby, these chemicals can reliably change a variety of cognitive and perceptual processes (both quantitatively and qualitatively). N,N-Dimethyltryptamine (abbreviated as DMT) is a prototypical exemplar of such psychoactive chemicals (DMT has been oxymoronically referred to as “the spirit molecule”; but see Strassman, 2001). The receptor binding affinity of DMT is complex and hitherto only partially understood. However, it has been firmly established that DMT non-selectively agonises several members of the 5-HT₂ (5-hydroxytryptamin also known as Serotonin) receptor family (especially the 5-HT_{2A} and 5-HT_{2B} receptor appear to be crucial for its psychoactive effects; but see McKenna et al., 1990; Aghajanian & Marek, 1999; Keiser et al., 2009). Except for the 5-HT₃ receptor, all 5-HT receptors achieve transmembrane signal transduction via the G-protein-coupled receptors. Recently, important fundamental research on the G protein-coupled receptor led to a series of Nobel Prizes (e.g., in 2000, 2004, and 2012).

Moreover, it has recently been demonstrated that DMT is an endogenous σ_1 receptor regulator (Fontanilla et al., 2009;) and it has been hypothesized that it plays a mediative role in tissue protection, regeneration, and immunity (Frecska et al., 2013). From a chemical point of view, DMT is a prototypical representative member of the indolealkylamine family known as tryptamines. In its pure form, DMT is a white/clear, pungent-smelling,

crystalline solid. Its molecular structural geometry visualized in Figure 1 is closely related to Serotonin.

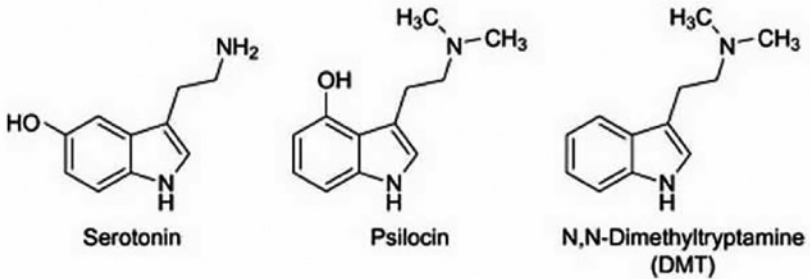


Figure 1. Compounds such as psilocin (synonymous with 4-hydroxy-*N,N*-dimethyltryptamine, a precursor of psilocybin which is also known as *O*-phosphoryl-4-hydroxy-*N,N*-dimethyltryptamine) and DMT (*N,N*-Dimethyltryptamine) have chemical structures that resemble the neurotransmitter serotonin (5-hydroxytryptamine). This structural similarity to serotonin allows them to stimulate serotonin-sensitive neurons. Note that the intermolecular serotonin motif is embedded in both structures.

From a phylogenetic perspective, DMT is an evolutionary very old molecule which is ubiquitously present in the plant and animal kingdom (Smith, 1977). In 1961, Nobel Prize laureate Julius Axelrod reported in the journal *Science* that the enzyme *N*-methyltransferase in a rabbit's lung is able to mediate the biotransformation of tryptamine into DMT (Axelrod, 1961). More recent converging evidence strongly suggests that DMT is an endogenous neurotransmitter in the human brain (e.g., Cozzi, et al., 2011; Fontanilla, et al., 2009; Cozzi, et al., 2009). Surprisingly, DMT is actively transported into the brain via the blood-brain-barrier (a process that is costly in energetic terms because it requires movement against the concentration gradient). This factum has been discovered by Japanese scientists 30 years ago (i.e., Yanai et al., 1986). Given that the brain in an extremely sensitive homeostatic organ, it constantly protects itself from toxins and undesired agents. Consequently, the blood-brain-barrier is highly selective and only very few essential compounds like glucose and other essential nutrients are actively moved across this membrane into the brains tissue. The phenomenon that DMT is *actively* transported across this protective barrier suggests that it plays a crucial role in ordinary brain metabolism. Moreover, DMT does not built up tolerance, as other psychoactive tryptamines do (no signif-

icant desensitisation after repeated administration; see Strassman & Qualls, 1994; Strassman et al., 1994) and it is quickly metabolised (consequently its duration of action is relatively short-lived) . Again, this indicates that it is a natural building block of mammalian neurochemistry. At the moment, there is no explanation as to why mammals have evolved an endogenous neurotransmitter that is able to produce profoundly altered states of consciousness. From an evolutionary point of view one has to ask the question: What is the adaptive advantage of this compound in terms of survival or reproduction? However, given that the intracellular cascade triggered by DMT is not yet fully understood it seems very difficult to imagine that science is soon able to account for its much more intricate effects on perception and consciousness (the hard problem) from a quantitative point of view.

DMTs qualitative phenomenology

From a psychological vantage point, DMT has very remarkable effects, too. One of DMTs most salient activity characteristics is that it affects visual perception in the most spectacular ways possibly imaginable. In addition, it profoundly changes the functioning of a multitude of core cognitive capacities. A brief (though incomplete) synopsis of DMTs subjective effects is summarised in the following list:

- Profound changes in sensory perception across modalities (e.g., perceptual distortions, vivid cross-modal hallucinations, visions, synaesthesia)
- Highly symmetric and oftentimes fractal multidimensional visual hallucinations of astonishing beauty and complexity
- Spectacular visual percepts (impossible objects which are essentially ineffable)
- Subjective experience of extrasensory perceptions (e.g., telepathic phenomena are commonly reported)
- Changes in time and space perception (e.g., time dilation, timelessness/experience of infinity/eternity, limitlessness/omnipresence)
- Journey-like “breakthrough into hyperspace” (trans-dimensional travel into parallel dimension and contact with conscious “otherworldly hu-

manoid beings” is commonly reported under high doses of DMT)

- Altered body image (e.g., out-of-body-experience, taking on an animal/alien body)
- Intense changes in mood (ranging across the whole spectrum of emotions from total serenity/bliss to extreme terror)
- Sense of profound meaning and deep spiritual insights (e.g., gnosis)
- Experience of very profound “mystical states”
- Dissolution of ego boundaries (e.g., ego-death, shared consciousness)
- Feelings of interconnectedness (e.g., communion with nature, monistic all-is-one experience)
- State of union and spontaneous realisation of oneness (nonduality, yoga)
- Near-death experience
- Experience of emptiness, nothingness, pure I-am-ness
- Feelings of tranquillity
- Being freed from one’s body and becoming integrated with one’s cosmic nature
- Feeling of sudden realisation of one’s homogenous cosmic essence
- State of inner harmony (Samadhi)
- Experience of a transcendental reality
- Collapse of ego-ignorance phantom (dissolution of self-limitation)
- Transformation of self-perception, transmutation of entire being (self-transcendence)
- Expansion of awareness (experience of boundless primordial awareness)
- Experience of higher states of consciousness
- Feelings of awe and wonder
- Feeling of awakening from an illusion to a larger “more real” reality
- Appreciation of nature (perception of nature as animated and alive, biophilia)
- Sudden insights into the nature of self and the nature of reality (epiphany or “satori” like experience - seeing into one’s true nature)
- Access to unconscious “Jungian alchemical archetypal” information

Potential adverse effects

- Acute panic reaction (depending on idiosyncratic personality structure and situation)

- Substance induced psychosis (ICD-10 diagnosis code F16.5 – low incidence rate)
- Hallucinogen persisting perception disorder (DSM-IV diagnosis code 292.89 – low incidence rate)

The following paragraphs reprint two experiences reported by research subjects who participated in Rick Strassman's early DMT which were conducted in Mexico in the 1990s.

“The trip started with an electric tingling in my body, and quickly the visual hallucinations arrived. Then I noticed five or six figures walking rapidly alongside me. They felt like helpers, fellow travelers. A humanoid male figure turned toward me, threw his right arm up toward the patchwork of bright colors, and asked, ‘How about this?’ The kaleidoscopic patterns immediately became brighter and moved more rapidly. A second and then a third asked and did the same thing. At that point, I decided to go further, deeper. I immediately saw a bright yellow-white light directly in front of me. I chose to open to it. I was consumed by it and became part of it. There were no distinctions—no figures or lines, shadows or outlines. There was no body or anything inside or outside. I was devoid of self, of thought, of time, of space, of a sense of separateness or ego, or of anything but the white light. There are no symbols in my language that can begin to describe that sense of pure being, oneness, and ecstasy. There was a great sense of stillness and ecstasy.” (excerpt taken from Strassman, 2001; p.244)

“Eight minutes into his non-blind high-dose injection, he described this encounter:

That was real strange. There were a lot of elves. They were prankish, ornery, maybe four of them appeared at the side of a stretch of interstate highway I travel regularly. They commanded the scene, it was their terrain! They were about my height. They held up placards, showing me these incredibly beautiful, complex, swirling geometric scenes in them. One of them made it impossible for me to move. There was no issue of control; they were totally in control. They wanted me to look! I heard a giggling sound - the elves laughing or talking at high-speed volume, chattering, twittering.” (excerpt taken from Strassman, 2001, p. 188).

It should be noted that the phenomenological experiences reported under the influence of DMT are interindividually very heterogeneous (perhaps partially due to a combination of genetically coded neurotransmitter receptor polymorphisms and idiosyncratic psychological variables) and are contingent upon set and setting (that is, internal psychological and external situational factors play an important role). However, several phenomenologies are reliably induced across diverse subjects (e.g., complex visual hallucinations, out-of-body-experiences, trans-dimensional travels, etc.).

Space does not permit a detailed discussion of DMTs experiential phenomenology, particularly because linguistic expressions are circuitous and often largely inadequate in order to convey its diverse spectrum of psychological effects (ineffability is a defining hallmark of the translinguistic DMT ontology which reaches far beyond the bounds of human imagination). The perceptions and insights that are catalysed by this compound are often described as being at total invariance with the socially grounded models of contemporary western paradigms. Interestingly, several of DMTs structural analogues (e.g., Psilocybin, a compound which is present in the “magic” mushrooms which are endemic to the UK, Mantle & Waight, 1969; see also Figure 1) have phenomenologically comparable though not identical effects (cf. Hasler et al., 2004). However, hitherto the extraordinary cognitive changes triggered by DMT cannot be accounted for by any of the existing theoretical frameworks provided by neuroscience and psychology.

Endogenous but prohibited

Despite the exceptional characteristics of DMT and its ubiquity in nature, many mainstream psychologists and even professional neuroscientists are utterly unaware of its existence (presumably, due to academic overspecialisation and the fact that the conventional neuroscience textbooks do not mention it at all, e.g., Gazzaniga & Mangun, 2014; Kolb & Wishaw, 2009). Furthermore, systematic and methodologically valid research is highly restricted due to the fact that DMT is classified as a “Class A drug” in the UK and similarly tightly regulated as a “Schedule I substance” in the US. This classification is clearly not evidence based and it inhibits scientific

progress and innovation (let alone the fact that it violates the principle of cognitive liberty, that is, the right to mental self-determination).

In this context, it is noteworthy that the Brazilian União do Vegetal (UDV - www.udv.org.br) was granted precedential legal permission to use a DMT containing drink (named Ayahuasca) in their ceremonies. The UDV, which is claiming roots as far back as the 10th century BC, utilises Ayahuasca in a program of spiritual evolution based on mental concentration and the search for self-knowledge. From a juridical point of view, it is very interesting that the US Supreme Court adjudicated in 2006 that the UDV is legally permitted to deploy Ayahuasca as a religious sacrament (under the protection of the “Religious Freedom Restoration Act”).

Ayahuasca: An ancient phytochemical synergy

From a much larger historical perspective, DMT has been utilized for spiritual/shamanistic rituals for millennia by several ancient cultural traditions. As mentioned before, it constitutes the active pharmacological principle in Ayahuasca, a plant based, drinkable concoction, which is traditionally used by indigenous tribes in the Amazonian rainforest for divinatory and healing purposes. In itself, DMT is orally inactive because the monoamine oxidase (MAO) system within the gastro-intestinal (GI) tract deaminates it. However, somehow the aboriginals have developed sophisticated intuitive knowledge concerning its combinatorial pharmacodynamics. In order to prevent DMTs decomposition in the gut, they mix it with a plant-based MAO inhibitor.

To be specific, the typical primary ingredients of the Ayahuasca brew consist of two plants, *Psychotria Viridis* (which contains the DMT) and *Banisteriopsis Caapi* (which contains the β -carboline harmala alkaloid designated as harmine). Harmine functions as a selective and reversible inhibitors of the enzyme monoamine oxidase A (MAO-A) that prevents the enzymatic breakdown of DMT in the GI-tract, thereby allowing it to be transported via the blood-brain barrier. Hence, it is the combination of these two plants, which enables DMT to become psychoactive. Quite thought-provokingly, the chemical literature labelled Harmine for some time as telepathine. This

chemical was so named because of the effects reported by Amazonian tribal members (e.g., telepathic communication, clairvoyance, precognition, psychic diagnosis, necromancy).

Western science has just relatively recently learned about DMT and its psychoactive effects from ethnopharmacologists who were able to conserve this ancient cultural knowledge literally in the last minute because old shamanic traditions are being extinguished at a fast pace by the modern industrial world. The inhabitants of the Amazonian rainforest have a very close relationship with, what they call “plant-spirits”. They regard Ayahuasca as a wise “plant teacher” which enables them to communicate with the “spirit world” (Beyer, 2009). It should be noted that in the shamanic paradigm the dichotomy between spiritual and medicinal is not clear-cut as the European heritage suggests and “sacred” plants play a central role in these traditional indigenous contexts.

Unfortunately, the Amazonian rainforests are currently being destroyed at a very alarming rate. The Amazonian biodiversity is among the richest in the world, although the number of species in the red list of the IUCN (International Union for Conservation of Nature) is growing steadily every year. The destruction of the natural environment goes hand in hand with the loss of culturally embedded ancient folk-knowledge concerning the utilisation of specific plants for medicinal and spiritual purposes. Moreover, younger generations are not very interested in the continuation of the Shamanic traditions of their predecessors. They prefer to move into modern technologized cities in order to take their place in the materialistic market economy and consequently thousands of years of accumulated and potentially highly valuable information is lost in this cultural transition.

Conclusion

Brevity does not permit me to review many intriguing aspects of this multifaceted topic (e.g., DMTs relation to psychological conditioning/extinction, neurogenesis, neuroplasticity, psychoneuroendocrinology, psychoimmunology, epigenetics, and the neuroanatomical correlates of its effects). I could

only try to provide a very rudimentary introduction to this fascinating newly emerging research domain. It should be emphasized that this subject (psychoactive plant compounds and human cognition, perception, and consciousness) is located at the cutting edge of modern cognitive neuroscience and psychology and it encompasses many other adjacent disciplines (e.g., physics, chemistry, botany, pharmacology, psychiatry, anthropology, history, archaeology, philosophy, religion, medicine, art, law, ethics, etc. pp.; cf. Bois-Mariage, 2002).). I am convinced that many researchers will develop a deep interest for this topic if they have not already done so.

For further information, the interested reader is referred to the book “DMT: The spirit molecule” by Rick Strassman (2001) who was the first to conduct FDA approved rigorous scientific human trials with DMT in the 1990s. His book provides a comprehensive synopsis of DMT’s neurochemistry and its experiential phenomenology. Strassman hypothesized back in the 90s that DMT might be present in the human pineal gland. This hypothesis was largely ignored by the scientific community. However, his prediction has recently been partially corroborated. In 2013, researchers first reported the presence of DMT in rodent pineal gland microdialysate (Barker, et al., 2013). The pineal is a photoreceptive endocrine gland whose primarily known function is the regulation of the circadian rhythm via the secretion of melatonin (N-acetyl-5-methoxy tryptamine), another serotonergic member of the tryptamine family (but see Reiter, 1991). Because the photosensitive pinealocytes have a strong resemblance to the photoreceptor cells of the eye, the pineal gland has also been labelled as the “third parietal eye” (Eakin, 1973). It has been subject to much speculation since Claudius Galenus and later René Descartes who famously termed it the “principal seat of the soul”.

Future research directions

To conclude, I would like to delineate some potentially fruitful directions for future research on DMT and formulate several empirically testable hypotheses:

DMT and its vastly more potent relatives (e.g., 5-methoxy-N,N-dimethyl-

tryptamine acronimized as 5-Meo-DMT) might lead to the discovery of new classes of neurotransmitter systems (cf. the discovery of the endocannabinoid system) that would deepen our understanding of basic neurochemistry and may ultimately lead to the design of new pharmacological agents in order to treat mental pathologies (cf. Jacob & Presti, 2005) or to enhance cognition (e.g., nootropics) or expand consciousness in the healthy population.

Another research agenda should focus the role of DMT and its relatives in molecular biology. The National Genome Research Institute published data that indicates that the costs of genetic sequencing (DNA micro arrays) are decreasing fast than Moore's law for computational performance predicts (<http://genome.gov/sequencingcosts>). This development opens up unprecedented large-scale analytic possibilities for the newly emerging discipline of neurogenetics. For example, in analogy to the genome, the proteome, and the connectome, the receptorome aims to map the total number of genes that code for receptors and receptor molecules in the brain. In this regard, it has recently been argued in a paper titled "Psychedelics and the Human Receptorome" that "it should be possible to use this diverse set of drugs (psychedelics) as probes into the roles played by the various receptor systems in the human mind" (Ray, 2010, p.1; content in bracket added).

The neurochemical correlates of the various meditative states of mind are another vibrant research topic. Researchers have observed statistically significant overlap between the neural correlates of meditation and psychedelic experiences. Consequently, there might be a significant degree of overlap between the neurochemical substrates of these altered states of mind. In this regards, the influence of DMT on microtubule (neuronal microstructures which form part of the cytoskeleton) should be a focal point of systematic scrutiny (but see Hameroff & Penrose, 2014).

Recent research provides evidence that DMT has psychoneuroendocrinological and psychoneuroimmunological effects (Frecka et al., 2023). Fascinatingly, it has been shown in a publication by Epel et al. in 2009 (co-authored by Nobel Prize laureate Elizabeth Blackburn) that meditation influences telomere length (an indicator of biological age). Given that

DMT and various related psychoactive tryptaminergic compounds induce states of mind that are partially qualitatively congruent with the mental states achieved by meditative practices it seems likely that the experiences triggered by DMT also have the potential to positively affect telomere length (e.g., via telomerase activity). Based on the assumption that DMT can induce robust longitudinal changes on various levels (physical and psychological) it seems likely that genetic changes are involved. Future research should focus on the (epi)genetic fundament of these changes (how gene methylation/transcription/ expression is altered following exposure to psychoactive substances).

Another line of research should investigate the interplay between quantum physical phenomena and altered states of consciousness. The theoretical framework of quantum physics ascribes a pivotal role to consciousness (e.g., Schrödinger's wave equation). Consequently, substances which profoundly change the main pillar of this theoretical tenet (that is, consciousness and the associated mechanics of perception) should be of significant interest to the physics community. The disciplines of physics and psychology should pursue a close interdisciplinary discourse and collaborations in order to combine their efforts and insights (this has happened before, for instance, the physicists Albert Einstein and Wolfgang Pauli were in close communication with depth-psychologist C.G. Jung).

Yet another auspicious line of research is an investigation of the effects of DMT on creative thinking and cognitive flexibility (i.e., DMT as a catalyst for creativity and innovation; cf. Frecska et al., 2012). Given that DMTs phenomenology deconstructs conventional orthodox cultural worldviews it has the potential to facilitate novel perspectives on multifarious philosophical questions and might even contribute to the resolution of "hard" scientific problems (cf. Willis, et al., 1966).

There is much more scientific virgin that soil awaits thorough investigation. A largely unexploited research area comprises of careful empirical tracings of the effects of various non-naturally occurring synthetic psychoactive tryptamines which have been developed by the pioneering chemist Alexan-

der Shulgin (see Shulgin & Shulgin, 1997). His work entails an extensive chemical toolbox for future work in neuroscience and psychology. In his book “TiHKAL - Tryptamines I have known and loved” he provides a detailed index of more than 50 psychedelic compounds (many developed by himself). The book entails a description of their synthesis, exact chemical structures, dosage recommendations, and qualitative comments. Most of these compounds have yet to be rigorously researched – a task for the next generation of curious and open-minded scientists. To provide an intriguing example, one of the tryptamines described by Shulgin is DiPT (Diisopropyltryptamine). It has unique properties because it does almost exclusively affect the auricular sense (i.e., nonlinear shifts in pitch perception - other sensory modalities remain largely unaffected). It is apparent that DiPT should be of keen interest to researchers trying to understand the neural basis of auditory perception. However, up until now systematic research has not been conducted (experimental ornithological studies of avian vocalisation/bioacoustics might be a fertile starting point).

Finally yet importantly, the experiences DMT evokes are of particular fascination to artists, for obviously reasons (e.g., Grey, 2012). Several visionary artists have been deeply inspired by their transcendental experiences with DMT and related compounds (see Figure 2).



Figure 2: The net of being by Alex Grey (inspired by the Mahayanian metaphor of Indra's net). Further artworks created by Alex Grey are available under the following URL: <http://alexgrey.com/art/>

Finally, it remains an open question why DMT (and its structural relatives) are not part of the mainstream discourse in psychology and neuroscience. Especially given its apparently central role in perceptual processes, its pertinence for consciousness studies, its implications for understanding mood disorders and emotions in general, and its far-reaching philosophical implications? A Kuhnian paradigm shift is needed. The study of naturally occurring (plant derived) substances should be allowed into academia in order to foster the elucidation of the interplay between psychoactive chemicals, cognition, and consciousness.

Off the Lip: Science over politics!

References

- Adams, C., Waldstein, A., Luke, D., Sessa, B. & King, D. (2013). *Breaking convention: Essays on psychedelic consciousness*. Devizes: Strange Attractor.
- Aghajanian, G.K. & Marek, G.J. (1999). Serotonin and Hallucinogens. *Neuropharmacology*, 21, 16-23.
- Axelrod, J. (1961). Enzymatic formation of psychotomimetic metabolites from normally occurring compounds. *Science*. 134(3475), 343.
- Barker, S.A., Borjigin J., Lomnicka, I., Strassman, R. (2013). LC/MS/MS analysis of the endogenous dimethyltryptamine hallucinogens, their precursors, and major metabolites in rat pineal gland microdialysate. *Biomedical Chromatography*, 27, 1690-1700.
- Beyer, S. (2009). *Singing to the plants: A guide to mestizo shamanism in the upper Amazon*. Albuquerque: University of New Mexico Press.
- Bois-Mariage, F. (2002). Ayahuasca : Une synthèse interdisciplinaire. *Psychotropes*, 8, 79-113.
- Cozzi, N.V., Gopalakrishnan, A., Anderson, L.L., Feih, J.T., Shulgin, A.T., Daley, P.F., Ruoho A.E. (2009). Dimethyltryptamine and other hallucinogenic tryptamines exhibit substrate behavior at the serotonin uptake transporter and the vesicle monoamine transporter. *Journal of Neural Transmission*, 116(12), 1591–1599.
- Cozzi, N.V., Mavlyutov, T.A., Thompson, M.A., Ruoho, A.E. (2011). Indolethylamine N-methyltransferase expression in primate nervous tissue. *Society for Neuroscience Ab-*

tracts, 37, 840.19.

Eakin, R. (1973). *The third eye*. Berkeley: University of California Press.

Epel, E., Daubenmier, J., Moskowitz, J. T., Folkman, S., Blackburn, E. (2009). Can meditation slow rate of cellular aging? Cognitive stress, mindfulness, and telomeres. *Annals of the New York Academy of Sciences*, 1172, 34-53.

Fisher, R.A. (1971). A cartography of the ecstatic and meditative states. *Science*, 174, 897-904.

Frecska, E., Mór , C.E., Vargha, A., Luna, E.L. (2012). Enhancement of Creative Expression and Entoptic Phenomena as After-Effects of Repeated Ayahuasca Ceremonies. *Journal of Psychoactive Drugs*, 44(3), 191-199.

Frecska, E., Szabo, A., Winkelman, M.J., Luna E.L. and McKenna, D.J. (2013). A possibly sigma-1 receptor mediated role of dimethyltryptamine in tissue protection, regeneration, and immunity. *Journal of Neural Transmission*, 120(9), 1295-1303.

Fontanilla, D., Johannessen, M., Hajipour, A.R., Cozzi, N.V., Jackson, M.B., Ruoho, A.E. (2009). The Hallucinogen N,N-Dimethyltryptamine (DMT) Is an Endogenous Sigma-1 Receptor Regulator. *Science*, 323(5916), 934-937.

Gazzaniga, M. & Mangun, G. (2014). *The cognitive neurosciences*. Cambridge, Massachusetts: The MIT Press.

Grey, A. (2012). *Net of being*. Rochester, Vermont: Inner Traditions.

Grof, S. (2000). *LSD-Psychotherapie*. Stuttgart: Klett-Cotta.

Hameroff, S. & Penrose, R. (2014). Consciousness in the universe: A review of the 'Orch OR' theory. *Physics of Life Reviews*, 11(1), 39-78.

Hasler, F., Grimberg, U., Benz, M.A., Huber, T., Vollenweider, F.X. (2004). Acute psychological and physiological effects of psilocybin in healthy humans: a double-blind, placebo-controlled dose-effect study. *Psychopharmacology*, 172, 145-156.

Huxley, A. (1954, 1956). *The Doors of Perception and Heaven and Hell*, New York: Harper Collins.

Jacob, M.S.& Presti, D.E. (2005) Endogenous psychoactive tryptamines reconsidered: an anxiolytic role for dimethyltryptamine. *Medical Hypotheses*. 64, 930-937.

- Keiser, M.J., Setola, V., Irwin, J.J., Laggner, C., Abbas, A.I., Hufeisen, S.J., Jensen, N.H. et al. (2009). Predicting new molecular targets for known drugs. *Nature*, 462(7270), 175–81.
- Kolb, B. & Whishaw, I. (2009). *Fundamentals of human neuropsychology*. New York, NY: Worth Publishers.
- McKenna, D.J., Repke, D.B., Lo, L., Peroutka, S.J., (1990). Differential interactions of indolealkylamines with 5-hydroxytryptamine receptor subtypes. *Neuropharmacology*, 29, 193-198.
- Mantle, P.G., Waight, E.S. (1969). Occurrence of psilocybin in sporophores of *Psilocybe semilanceata*. *Transactions of the British Mycological Society*, 53(2), 302-304.
- Ray, T.S. (2010). Psychedelics and the Human Receptorome. *PLoS ONE*, 5(2), e9019.
- Reiter, R.I. (1991). Pineal gland. Interface between photoperiodic environment and the endocrine system. *Trends in Endocrinology and Metabolism*, 2(1), 13-19.
- Shulgin, A. & Shulgin, A. (1997). *Tibkal: The continuation*. Berkeley, CA: Transform Press.
- Smith, T. (1977). Tryptamine and Related Compounds in Plants, *Phytochemistry*, 16, 171-175.
- Strassman, R. (2001). *DMT: The spirit molecule: A doctor's revolutionary research into the biology of near-death and mystical experiences*. Rochester, Vt: Park Street Press.
- Strassman, R.J., Qualls, C.R. (1994). Dose-response study of N,N-dimethyltryptamine in humans. I. Neuroendocrine, autonomic, and cardiovascular effects. *Archives of General Psychiatry*, 51(2): 85-97.
- Strassman, R.J., Qualls, C.R., Uhlenhuth, E.H., Kellner, R. (1994). Dose-response study of N,N-dimethyltryptamine in humans. II. Subjective effects and preliminary results of a new rating scale. *Archives of General Psychiatry*. 51(2), 98-108.
- Harman, W.W., McKim, R.H., Mogar, R.E., Fadiman, J., Stolaroff, M.J. (1966) Psychedelic Agents in Creative Problem-Solving: A Pilot Study. *Psychological Reports*. 19, 211-27.
- Yanai, K., Ido, T., Ishiwata, K., Hatazawa, J., Takahashi, T., Iwata, R., Matsuzawa, T. (1986). In vivo kinetics and displacement study of a carbon-11-labeled hallucinogen, N, N-[11C]dimethyltryptamine. *European Journal of Nuclear Medicine*. 12, 141-146.

The formational imaginaries of space technology as an issue of cognitive innovation

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Abstract

The paper concerns the cognitive shaping of space technology. It addresses tendencies and framings in the visual imaginaries formational to the actual production of space technology and which pervade the operational frame of reference of the space industry.

From the evidence of anecdotal reports and visual documentation there is a visual genre to the formational imaginaries that space technologists refer to when describing their visions. Among these are 'towers to the sky' that inspired the geostationary orbit and the (in process) space elevator. These cartoon-like imaginaries spill into diagrams of disproportionately large satellites in space sending signal over vast 'footprint' areas of Earth with a seemingly invincible capability to connect and survey.

Spaceflight lends itself to visual imaginaries by the graphic allure of starkly lit objects set against the black background of space and often depicted in illustrations from a 'god's-eye view'. The visual characteristics of mediated and imagined images of spaceflight raise questions as to what is framed and what is left out of the frame. If there is an inherent bias in what is seen and not seen in the mind's eye of the space technologist, are there consequences to this? How does the mediated image of spaceflight inform what is made and shape what space technology is thought to be? What techniques of cognitive innovation might be used to counter the potential normalisation

of cultural myths and other hidden assumptions into the fabric of space technology via visual norms and under-critiqued visual imaginaries?

The paper presents speculative proposals for an underdeveloped correspondence between aesthetic interventions and determinants of technological development. The intervention of the artistic, aesthetic and creative into the work spaces of space agencies indicate a claim for inclusion in the frame and suggests art/science collaboration is a way to share not only the material realm of production but more urgently the cognitive, immaterial realm that shapes what technologies are thought to be.

Keywords space technology, cognitive innovation, visualisation, technological imaginaries

1 Introduction

The ideas I present draw on my thesis research that focused on responses to the Moon mission of the Chandrayaan spacecraft, which was launched by the Indian space agency ISRO in 2008. At the time of the launch I was invited to Bangalore, the city where the spacecraft was assembled, to lead a project called Moon Vehicle as a creative, cultural and educational response to the explicitly scientific rationales of the mission. The thesis I wrote builds a context for why this creative initiative came about, in order to more clearly focus on elusive aspects of the consequences of space technologies (Griffin, 2014).

Moon Vehicle was in many ways an activist project and motivated as a protest against the exclusion of the arts and humanities from the cognitive, conceptual and work spaces of space mission design. Space agencies are in their own terms highly multidisciplinary, but they are nonetheless science and technology institutes, while the project of going into space is a wider, transdisciplinary project. Internationally, the space industry presents itself as all-inclusive. The annual gatherings of the space industry at the International Astronautical Congress carry taglines that proclaim the universal nature of their projects. Some examples are: "Space for Inspiration of Humankind"

(Fukuoka, 2005), "Bringing Space Closer to People" (Valencia, 2007), "Touching Humanity" (Hyderabad, 2007), "Space Science and Technology for the Needs of All" (Naples, 2012) and "Promoting Space Development for the Benefit of Mankind" (Beijing, 2013). With these statements, those who make space technology shape what it is thought to be and whom it is thought to be for. Such aspirations are deeply ambivalent in their implementation. It is not difficult to see in the claims reviewed the marketing tactic of an industry reliant on public funding for its long-term, costly activities. The decisions pertaining to what to do in space, why to go, where to go, how to learn, preserve and interact with outer space environments are determined by a select community with an uncertain claim to represent the larger picture of humanity and non-humans.

What initially motivated my work, as an artist, to look critically at space technology, was a sense of cognitive injustice at the presumption that the technological interaction with space would only be inscribed by the discipline of science. In a sense the only way forward was through an aesthetic route (Williams, 1993). Unable to enter the space agency or to directly use or influence the construction of technology, the only intervention was aesthetic – to reshape the imaginary of what Chandrayaan was thought to be using the visual alacrity of artistic practice in an expanded field of art/science collaboration and experiential learning.

This talk addresses the cognitive shaping of what space technology is thought to be by offering the proposition that the imagined image of space technology, as a site of visual production, could be opened to critique in new ways through the notion of cognitive innovation.

2 Ways of Seeing Space Technology

I begin by contrasting my experiences of seeing the Chandrayaan spacecraft, with image tropes that reveal formational imaginaries of spacefaring. In a sense this is about looking at the beginnings and endings of technologies in a pictorial way and speculating how outcomes and consequences might feed back into the formational or conceptual stages of technology production.

But what is the picture of something that cannot be seen? An engineer's drawing may capture a beginning, but the story of the life of a mission and the figuration of what it does in the world and solar system when the machine begins to work, is in comparison to a drawing, a vision of filmic and multi-sensorial dimensions. I call my own grounded experience of seeing space technology a 'technographic picture', developing Steve Woolgar's idea of the 'technography' (1998). A picturing characterised usually by both the absence of the spacecraft and the ontological difficulty of ever separating figure from ground – spacecraft from infrastructure, technological from social, material from immaterial. A complex, overlaid and constantly reconstructed imagined image that is perpetually difficult to grasp, for which there is no overview, no "god's eye" view, no totality.

This technographic picture differs altogether to a style of picturing that I have encountered when asking space technologists about the formational imaginaries that steer their projects. In contrast, the images of future projects I have heard described or watched being presented have frequently been cartoon-like, presenting easily graspable, universal realities. It is this dissonance between the collage-like picture conjured by an experience of the social domains of space technology and the cartoon-like pictures used to propel future space technologies that is the subject of speculation in this paper. For this conference a question I raise is whether there is a problem with the formational imaginaries of spacefaring that a project of cognitive innovation could address? The problem I suggest is that formational imaginaries of space technology are a site of visual production that eludes critique because the topic, most often referred to in science institutes as "pretty pictures", is not considered to be a serious determinant of technological production. In this paper I gather some evidence that contradicts this view and indicate how the low status of the visual in scientific practice is one of the motivators of artistic intervention.

The photo in Figure 1 shows Chandrayaan being transported on a pick-up truck. It is an exhibition model, but also an uncanny reminder of the iconic photographs taken in the early days of India's space programme: one of a Rohini rocket being transported on the back of a bicycle (taken by Henri

Cartier Bresson) and another of the APPLE satellite being transported on a bullock cart. The fuller stories of these images indicate that neither was a usual method of moving rockets or spacecraft, but they have nonetheless been readily adopted into the nation's technological mythology and *Bullock Carts and Satellites* (Bobb, 1985) is a popular school text book. The photos of the Chandrayaan model illustrate two themes: one is the way space technology is seen when it is absent and the other is the mobility of the imagined image of space technology.



Figure 1: Photograph of an exhibition model of the Chandrayaan spacecraft being transported in Bengaluru (© 2010 Joanna Griffin)

How is space technology seen? Unlike cars, helicopters or trains, spacecraft are seen directly by very few especially in their orbital habitat. When the Moon Vehicle project began the students I worked with had the opportunity to go and see Chandrayaan in the clean room workshop where it was being assembled. They came back and described what they had seen with

great confusion. Seeing the spacecraft directly, for non-specialists at least, was distinctly unrevealing. Seeing is an extraordinarily rich and dynamic process. We see images and objects in the environment, but we also see through other people when they tell us of what they have seen. We create pictures from things we hear about and never see. Drawings can leave a trace of those processes. This drawing by Prashant (Figure 2), a pupil at Drishya Learning Centre who was a participant in a two-week Moon Vehicle workshop (described more fully in Griffin, 2012) struck me at the time it was drawn as a depiction charged with mythology with its lizard-like moons with arms and legs flying with the Chandrayaan spacecraft.

Gradually, however, I noticed potential sources of the drawings in material circulated by the ISRO space agency and in adverts the children had spotted in newspapers and combined into their book cover collages (Figures 3 and 4). The drawing is not a copy, but a reconstitution that traces how imaginaries are shared and circulated in dynamic processes of re-interpretation.



Figure 1: Photograph of an exhibition model of the Chandrayaan spacecraft being transported in Bengaluru (© 2010 Joanna Griffin)

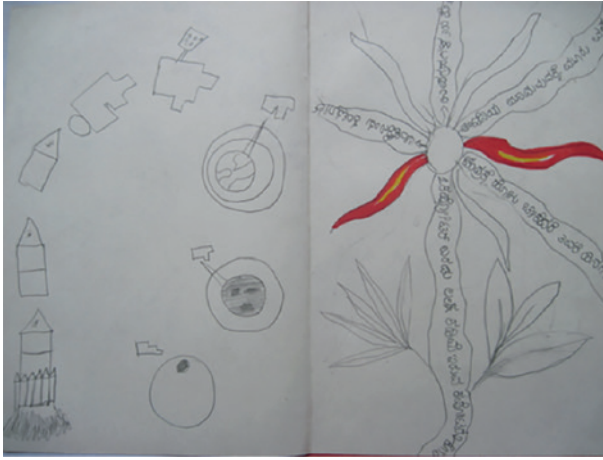


Figure 3: Drawing by Shivashakti, a pupil at Drishya Learning centre, drawn after a visit to the ISRO Satellite Centre in Bengaluru and the Indian Deep Space Network tracking station that tracked the Chandrayaan spacecraft's flight.

The image above (Figure 3) came about in part because our guides at the Deep Space Network tracking station described the dish-shaped antennas as like the petals of a flower. The description resulted perhaps in this glitch of a magnificent flower-like drawing. These examples are a reminder that the images we tend to see of spacecraft are almost always mediated and personalised. We see different pictures of the same things.

With the groups I worked with during Moon Vehicle we found ways to access space facilities, but we also worked hard to access space scientists and in the informal conversations we had about their work, the landscapes of the Moon felt closer as Chandrayaan's international mission team conveyed their familiarity with the Moon's surface developed over years of study. At the time I wrote the following about this way of seeing space technology through the testimonies of scientists:

Listening to these informal conversations rendered the instrumentation invisible. Instead the scientists themselves became the medium of interpretation, subsuming the technology, which they themselves

had anyway constructed. Compared to looking at the spacecraft in the clean room, here in these conversations was access not to the spacecraft but to its viewpoint. (Griffin, 2012)

These grounded and nuanced ways of seeing space technology contrast with the archetypal visuality of objects in space starkly lit by light that does not pass through an atmosphere, but hits directly. Space technology is in many ways a special case because the graphic allure of sharply defined objects against a black background make it supremely alluring visually, and therefore memorable. The image of technology in outer space holds an ineluctable draw, like a cinema screen when the lights go down.

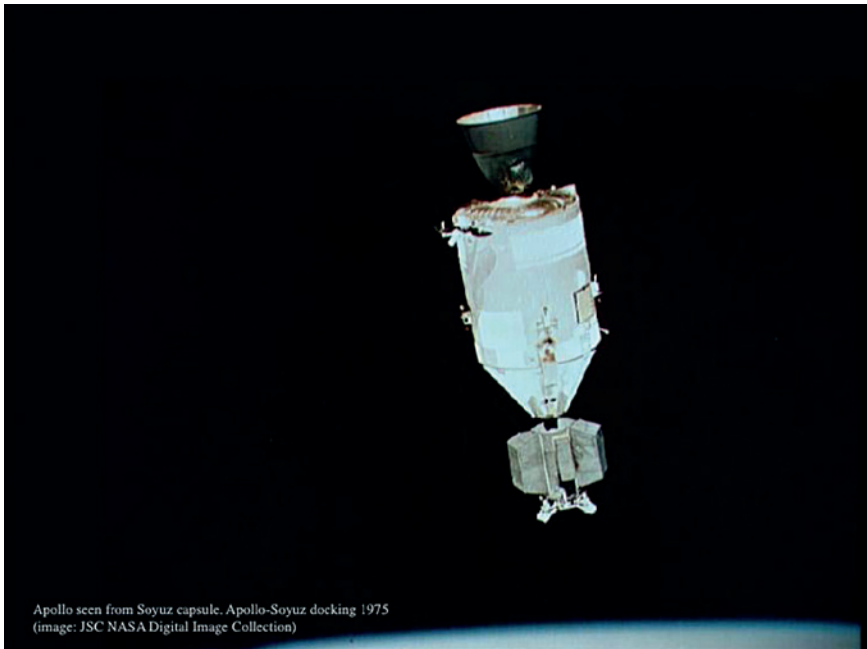


Figure 4: Photograph of the Soyuz craft during the Soyuz-Apollo docking manoeuvre in 1975 as seen from the Apollo capsule (Image: JSC NASA Digital Image Collection)

This photograph (Figure 4) taken during the Soyuz-Apollo docking in 1975 produced an image of friendship between the Soviet Union and United States. The image created by space technology is of course extremely useful

politically because it influences the way it is thought about. International relations scholar Michael Sheehan writes of images guiding activity in outer space:

By firmly establishing a specific perception of outer space, a dominant narrative helps to shape a particular reality. We perceive outer space in a particular way, as a particular kind of realm, in which certain types of activity are possible, even expected, while others are frowned upon or specifically forbidden. (2007)

Seeing is not just about the visual, it is also about the way we think. Bruno Latour, the anthropologist of science and technology writes in his 1986 paper 'Visualisation and Cognition: Drawing things together' that visualisation and cognition have to be kept in the same focus. While his analysis does not take in the imagined as a site of visual production, visualisation and cognition are inseparable not least because images become mobile through imagination and through shared imaginaries. Imagined images are not captive in our minds but are actively disseminated between us and as such the imagined image is a form of visual production.

3. Space Industry Pictures

Having given some sense of ways of seeing that I have investigated as an artist and for which I use the term the technographic picture to encapsulate a counter-intuitive and nuanced complexity to seeing and imagining, I want to report some anecdotes about images that raised my curiosity about the currency and characteristics of images and imagined images within the space industry.

As part of the International Astronautical Congress in Naples in 2012 at which I was presenting there was a showcase of space industry products. At the Japanese space agency stand I picked up a plastic folder with a *Hello Kitty* astronaut and rocket parts design (Figure 5a). Next I went over to the British Interplanetary Society stand and was handed one of their journals. Flipping through the journal I saw an image of almost exactly the same

rocket parts, a depiction of a satellite emerging from the nose-cone of the third stage of a rocket (Figure 5b). It was the cover of *Spaceflight* journal in 1959 showing a drawing by John W. Wood.

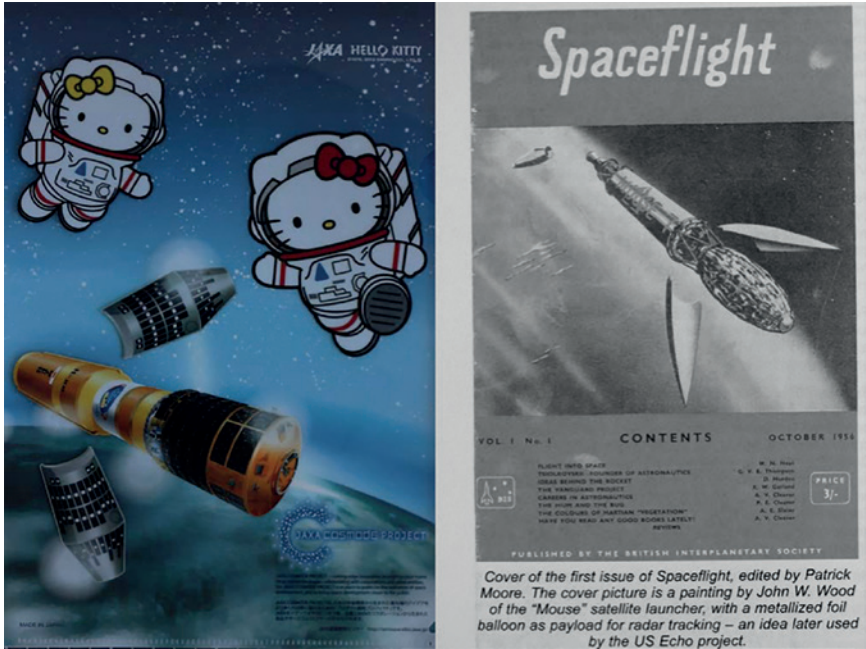


Figure 5: On the left (a) a plastic folder with a Hello Kitty design that I picked up from the Japanese space agency (JAXA) stand at the Naples International Astronautical Congress in 2012. On the right (b) an image in the British Interplanetary Society's journal which I was handed at their stand not far from JAXA's.

At the same event I sat down for a coffee and got chatting to Jerome Pearson who was the executive director of the Space Elevator. This is the idea that instead of rocket launches you build a lift into orbit. I asked him where he got his idea from and he said, "Oh it was from hearing Arthur Clarke explain the geostationary orbit. He'd said, imagine towers going to the skies with satellites on top of them" and this is what made him think a real tower could be constructed. Pearson wrote a technical treatise in 1975 and has ever since been advocating the space elevator (which to his credit is in development).

Not long after, back in Bangalore, I attended an inauguration for a new show at the Planetarium where the former ISRO chairman U.R. Rao stated that ISRO would plant pine trees on Mars. A pattern of resilient imagery, and to my mind alarmingly naive imagery, was beginning to be apparent. At the Global Lunar Conference in Beijing, I began to photograph the Power-Point screens every time a Moon Village was shown to collect the repetition of similar visual projections all normalised by their computer-generated surfaces. A paper by one of the three conveners of the conference, Bernard Foing the Executive Director of the International Lunar Exploration Working Group (ILEWG), described his idea to create a "Noah's Ark" on the Moon of Earth's species. These formational imaginaries of future space technology trajectories were surprisingly graphic – towers to the sky, green pine trees on red Mars and Noah's Ark – and as a genre, cartoon-like. Yet how much would happen, and had happened, as a result of such explicit, perhaps simplistic, projections. The resilient nature of the images, the way they repeated across decades, also suggested that the kinds of images being thought of by space technologists were not being thought about enough. They were perhaps the clichés and tropes of an industry not given to visual critique.

Such images serve a very particular purpose. When Bruno Latour looks at the determining power of images within science and technology fields he points out that in order for projects to be taken up you have to be the winner, you have to be *"the one able to muster on the spot the largest number of well-aligned and faithful allies"* (1986, p. 5, italics in original) and cartoons make the complex seem graspable and doable. Animator Walt Disney and rocketeer Werner von Braun understood the pact between the image of technology, the shared imaginary, the mustering of allies and the making of space technology when they created the Tomorrowland series *Man in the Moon* in 1955, which purportedly influenced President Eisenstein's decision to back a satellite programme. This is why visualisation and cognition must be considered together, why the image and imaginary are locked in the same focus, because what we are looking at in these formational imaginaries is, "the way in which someone convinces someone else to take up a statement, to pass it along, to make it more of a fact..." (Latour, 1986, p. 5). The

cartoon imagery is necessary to muster the cities of people necessary to take space projects through their thirty year trajectories, or more.

4. The Production of Imagery

To begin to gauge the resilience of formational imaginaries and their influence on future production I started to follow one of these leads to see how it would help illuminate my misgivings. The *Spaceflight* journal cover that I had spotted in the British Interplanetary Society journal led me to the British library and the series of journal covers from 1959-63 to see what kinds of images were being used at that time. Putting the covers into categories revealed a number of prevalent themes such as the spacecraft with the planet behind. In these, the scale of the spacecraft becomes equivalent to the planet and inflates the significance of the enterprise. It is the classic 'view from nowhere' that Hannah Arendt used to associate science and spaceflight with the arrogance of Archimedes' boast that given the correct point of purchase – somewhere out in space – he could lever the whole world (Arendt, 1963; Haraway, 1988). The next highest number of cover images was for space artefacts, particularly colossal and round, then launches of course and there were two covers with people.

So to begin to informally look at the resilience of such images from the early days of spaceflight I went to *Spaceflight Now*, a feed on Facebook from the online journal *Spaceflight Now* and I looked to see what types of images they used.

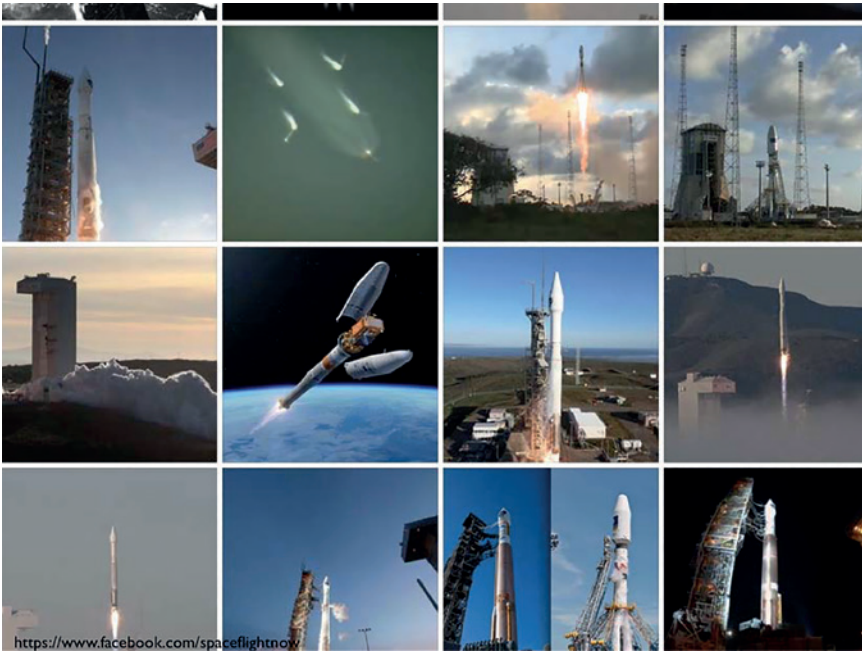


Figure 6: Screenshot of photos from the *Spaceflight Now* Facebook page.

Here were sometimes identically framed images of lift-offs, spacecraft the size of planets, a satellite emerging from the nose-cone of a rocket and large, round, impressive rockets (Figure 6). One day in 2012 I saw an image on the feed that framed a slightly different narrative. The focus was pulled and flowers in grasses were in the foreground. Unexpectedly there was a reference to an encircling and landscape beyond the frame. I wrote a comment somewhat sarcastically commending this new awareness of the extension of affect beyond the habitually adopted image of space technology disconnected from the social and environmental. A week or so later another striking image came up on the feed of people watching a launch from Playalinda Beach, Cape Canaveral.



Figure 7: Photo from the Facebook stream of *Spaceflight Now*

The way these images stood out from the rest made me wonder when do formational imaginaries fade? Or are they resilient? Do they mature and continue to frame the visuality of what is produced? And what is left out of the picture? What is going on in the blind spots produced by too narrow a framing?

6. Landscapes and blindspots

The experiences of seeing Chandrayaan that I gave at the beginning of this talk, indicate how activities such as Moon Vehicle worked at producing a counter-visuality (Mirzoeff, 2011) aimed at shifting established imaginaries. In a sense the project was innovating visualisation in order to address cognitive exclusion.

There are a small number of studies that focus on the asymmetric nego-

tiations between space facility communities and their more established neighbours. The space archaeologist Alice Gorman has written compelling accounts of the space histories at Woomera launch site in Australia to include Aboriginal residents of the landscape (2005). Both she and Peter Redfield have made similar studies of the launch site in Kourou, French Guiana used by the European Space Agency (Redfield, 2000; Gorman, 2007). Lisa Parks' work has also looked at cultures of space and cultures affected by space technology in ways habitually left out of the dominant picture (2005). When I visited the Deep Space Network at Bylalu south of Bangalore, the small team of systems scientists told me of their need for armed protection during their journeys to work while the development of the new facility for Chandrayaan was underway. Just as Woomera launch site had taken over sacred land from Aboriginal residents, so ISRO incorporated a family temple inside the perimeter fence that the family was not allowed to access, particularly because of the form of Hinduism they practised was lower caste. The science team let me know that this was not a problem because now ISRO security guards used the temple.

Looking just outside the dominant frame of reference is revealing of subaltern viewpoints. The histories and landscapes of space technology development are complex pictures. To see them in many ways requires turning away from the habitual representations, but also finding a mode by which to imagine and visualise. The pervasive imaginaries that propel space missions may also be obviating what I have termed in my own research the technographic picture – the image of technological infrastructure as social and as affect and as landscape that counters the alluring but narrow framing of rockets and spacecraft.

Imagining a technographic picture reveals landscapes and blind spots in the diffused light on earth. Such a mode of visualisation may be a process currently in formation through transdisciplinary interventions and initiatives such as Moon Vehicle and Cognovo. An ongoing project of cognitive innovators is to understand the cognitive limitations of large-scale technological systems using artistic practice to access and change imagined visibility.

References

- Arendt, H. (1963) 'The Conquest of Space and the Stature of Man'. *The New Atlantis*, 18 (Fall 2007), pp. 43-55 [Online]. Available at: <http://www.thenewatlantis.com/publications/the-conquest-of-space-and-the-stature-of-man> (Accessed: 15 September 2012).
- Bobb, M. (1985) *Bullock-carts and Satellites: The development of science and technology in India*. New Delhi: Director, National Book Trust, India, Ministry of Human Resource Development, Government of India.
- Gorman, A. C. (2005) 'The Cultural landscape of interplanetary space'. *Journal of Social Archaeology*, 5 (1). pp 85-107.
- Gorman, A. (2007) 'La Terre et l'Espace: Rockets, Prisons, Protests and Heritage in Australia and French Guiana'. *Archaeologies: Journal of the World Archaeological Congress*,
- Griffin, J. (2012) 'Moon Vehicle: Reflections from an artist's-led children's workshop on the *Chandrayaan-1* spacecraft's mission to the Moon'. *Leonardo*, 45 (3), pp. 218-224 DOI: 10.1162/LEON_a_00363 [Online]. Available at: http://www.mitpressjournals.org/doi/pdf/10.1162/LEON_a_00363 (Accessed: 2 May 2014).
- Griffin, J. (2014) *Experience and Viewpoints in the Social Domain of Space Technology*. [PhD Thesis] Plymouth University.
- Haraway, D. (1988) 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective'. *Feminist Studies*, 14 (3), pp. 575-599 [Online]. Available at: <http://links.jstor.org/sici?sici=0046-3663%28198823%2914%3A3%3C575%3ASKTSQI%3E2.0.CO%3B2-M> (Accessed: 4 February 2014).
- Latour, B. (1986) 'Visualisation and Cognition: Drawing Things Together'. in Kuklick, H. (ed.) *Knowledge and Society Studies in the Sociology of Culture Past and Present*. Jai Press, pp 1-40.
- Mirzoeff, N. (2011) *The Right to Look: A Counterhistory of Visuality*. Durham: Duke University Press.
- Parks, L. (2005) *Cultures in Orbit: Satellites and the Televisual*. Durham and London: Duke University Press.
- Redfield, P. (2000) *Space in the Tropics: From Convicts to Rockets in French Guiana* Berkeley and Los Angeles: University of California Press.
- Sheehan, M. (2007) *The International Politics of Space*. London and New York: Routledge.

Williams, R. (1993) 'Cultural origins and environmental implications of large technological systems'. *Science in Context*, 6 (2). pp 377-403

Woolgar, S. (1998) 'A New Theory of Innovation?'. *Prometheus*, 16 (4). pp 441-452.

Zabusky, S. E. (1995) *Launching Europe: An Ethnography of European Cooperation in Space Science*. Princeton: Princeton University Press.

Perception of Intended Emotion in Drawings by Non-artists

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1 Abstract

A corpus of 442 coloured drawings made by 22 children, 28 adolescents, 15 younger adults and 11 older adults depicting six different emotions were rated for emotional content by eight judges untrained in art. The colours used in the drawings were also analysed. As in a previous study, emotional descriptors of happiness and sadness were more frequently given by judges than were other descriptors for all emotional scenes. Happiness was more frequently seen in depictions of happiness and sadness than were other emotions. Other emotional scenarios, however, were more frequently described with emotional words unrelated to the intended emotion in the drawing. In previous studies it has been shown that there is a spectrum of colours typically related to a range of emotions in drawing, painting, pointing and naming tasks. The direction of association, however, appears to be expressive. While emotion names can evoke specific colours, colours per se do not evoke emotional categories as reliably. This relationship resembles the inducer-concurrent roles in synaesthesia and may be related to synesthetic phenomena.

Keywords colour, emotion, drawings, non-artists

3 Introduction

Colours provide aesthetic experience and emotional expression even in widely available colouring books purported to be therapeutic relievers of stress (see Elves 2015.). Several previous studies have shown that there are statistically reliable associations between emotion words and colours in drawing, painting, colouring book, naming, and pointing tasks (See Lucyk, Purchase & Humphrey 2014). While some researchers have found that these associations are less consistent in some contexts such as housing colours (Dupuis 2012) use of coloured glasses (Garrison 2012), coloured surfaces (Willits 2007), (but see also N. Humphrey's (2006) evidence with room and lighting colours), the frequency of these common associations in drawings and painting, particularly of clothing (Baxter 2007), suggest that there may be "naturally-biased" associations between emotion words and colours, particularly with colours of objects. Maurer, Gibson and Spector (2013) found naturally biased associations between letter shapes and colours in young children, as well as in adults. They suggested that these associations may be related to early synesthetic connections in infants. Many of the connections related to early synaesthesia are pruned away during normal neurological development into childhood (Simner 2013). Ramachandran and Hubbard (2006) suggest that these early connections might be the basis of language and metaphor. Pixar's (2015) film "Inside Out", for example, uses various colours to depict animations of personified emotions in a colour range similar to those found in our previous studies. Anger is red, Joy is yellow, Disgust is green, Sadness is blue and Fear is purple in the movie- although we more often found an association between fear and black. These associations have been found in a wide range of ages (Vandewiel 2010), in art students (Rivard 2004) and in Chinese-Canadian students (Lalor 2003). The direction of the association is strongest from the emotion word to the colour. Thus it is easy to demonstrate that colour is used expressively in drawing and painting to suggest emotion. In the present study we wish to show how the expressive use of colour is perceived by the viewer. Drawings by non-artists were viewed by non-artist judges who provided emotional descriptors for the drawings.

4 Method

4.1 Drawings

4.1.1 Participants. Drawings were made by seventy-six participants (Baxter 2007); 22 children (12 females) 8 to 10 years of age, 28 adolescents (22 females) 17 to 19 years of age, 15 younger adults (6 females) 30 to 59 years of age, and 11 older adults (5 females) 60 to 85 years of age. Participants were recruited from local schools and social groups in London, Canada. None had specialized training in art.

4.1.2 Materials. Six sheets of white paper and twenty-four Crayola crayons were provided with six scenarios to be depicted as follows:

1. Happiness: Your best friend is taking you out for dinner.
2. Anger: You wait in line for several hours when the line closes.
3. Sadness: Your best friend moves far away.
4. Surprise: Your best friend arrives unexpectedly.
5. Disgust: Someone vomits on your shoe.
6. Fear: A stranger attacks you with a knife.

4.1.3 Procedure. Participants made six drawings individually in a separate room. They were given the scenarios described orally in a randomized order.

4.2 Judging

Nine judges (five females) aged 19 to 65 years of age untrained in art recorded in writing associated emotion words for the drawings. Eight judges saw a random sampling of half of the drawings. One judge looked at all of the drawings. A list of suggested emotion words was provided to the judges as follows; anger, surprise, happiness, disgust, sadness, fear, embarrassment, love, pride, guilt, and empathy . Any other words provided by the judges were also recorded. Drawings containing symbols such as words or letters or conventional graphic symbols such as heart shapes or tears were not included in the analyses.

5 Results

5.1 Colour

Colour use was tabulated by two observers. Only colour categories showing 100% agreement were included in the analyses. The use of colour in drawings of the six emotional scenarios shows some similarity to previous findings. Average proportion of drawings of each emotion using twelve colour categories is shown in Figure 1.

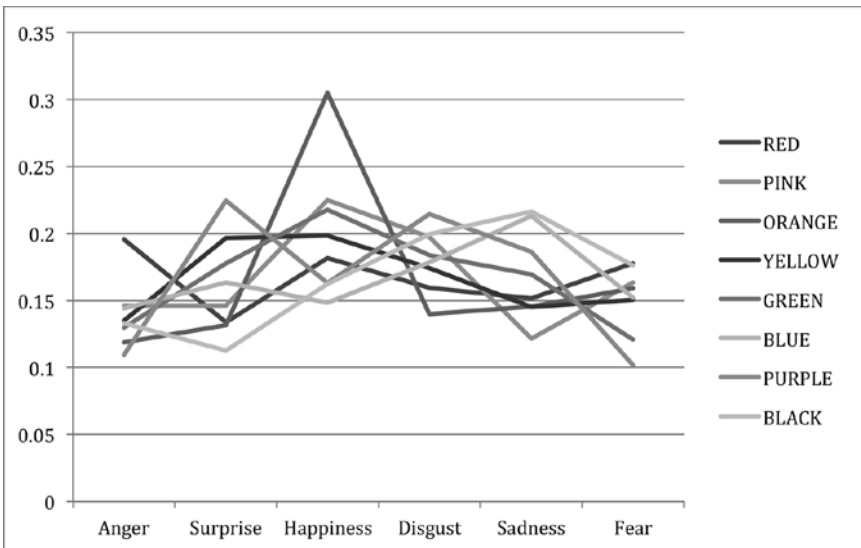


Figure 1. Proportion of drawings of emotions using twelve colours.

Colours most frequently used in emotion drawings were red for anger, purple for surprise, orange for happiness, purple for disgust, blue/black for sadness and black/red for fear.

5.2 Emotion Ratings

The average proportion of drawings described by the emotion words anger, surprise, happiness, disgust, sadness, and fear are shown in Figure 2. Other

descriptors were also used by judges but are not presented here. Not all drawings of emotions were seen as depicting the intended emotion categories. Overall, happiness and sadness were the most frequently used emotion categories by judges irrespective of the emotion category suggested for the drawings to participants in Baxter's (2007) study. The prevalence of the use of happiness and sadness in describing emotional scenarios has been found before (Humphrey, Lucyk, Purchase & Vandewiel 2015). Not surprisingly drawings of happiness and sadness were most often described as happiness and sadness respectively. The term anger was most often used to describe scenes of surprise, surprise to describe happiness, happiness to describe happiness, disgust to describe disgust, sadness to describe sadness and fear to describe surprise.

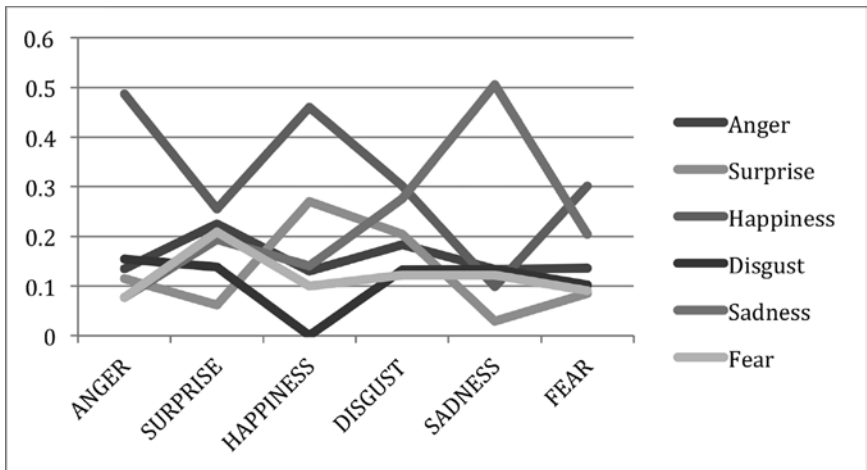


Figure 2. Average proportion of drawings described by each emotion word for each emotion scenario.

6 Conclusions

Although both drawers and viewers in this study were untrained in art there is some evidence that emotions can be portrayed successfully in drawings in ways that viewers recognize. Virtually all of the categories of drawings were described as portraying the intended emotion by at least some of the judges. The most frequently used emotion words to describe the drawings were

sadness and happiness. Also, sadness and happiness were used to describe drawings of sadness and happiness most frequently. Thus, the consistency between depicted and perceived emotion categories in drawings is strongest with sadness, and happiness. Disgust is also used most frequently to describe drawings of disgust, although other descriptors are also used to describe all drawings.

All of the drawings, except for drawings of happiness that were never described as portraying disgust, were described by all of the emotion words by at least some of the judges. Thus a range of emotions was seen in most drawings. It is also likely that the drawers intended to portray more than one emotion within one drawing. Human scenarios encompass more than one emotion, particularly with more than one character (Lucyk 2014; Purchase 2014). Furthermore, it is unlikely that one formal characteristic of a graphic representation will map onto one emotion category, like a kind of paint-by-number code. Rather, formal characteristics such as colour are available to the artist in a complex, nuanced toolkit in the service of portraying emotion in the human condition. This toolkit exploits the natural associations that resemble the inducer-concurrent associations in synaesthesia. In the case of colour and emotion the inducer is the named emotion while the colour is the concurrent. This direction of association would be expected in an expressive task, such as the making of drawings. The perception of the intended expression might be more ambiguous to the viewer than to the artist, as it appears to be in the current findings. The relation of such associations to metaphor and language has been discussed by Ramachandran and Hubbard (2006).

Many more questions remain following this exploratory study. For example, is it easier to perceive the intended emotional expression in abstract than in representational drawings? On the one hand, abstract drawings are simpler and therefore may be more emotionally potent. On the other hand it may be harder to decipher simpler drawings without the information provided by representational details.

The role of cultural connotations of colour cannot be ignored, although they are difficult to separate from “naturally-biased” associations between emotion words and colours. Palmer and Schloss’ (2010) Emotional Valence Theory (EVT) suggests that colour preferences are based on object-colour

associations and the emotional valences of objects. The idea that emotional valence mediates preference points to the role of emotion-colour associations in aesthetic questions. The present study investigates the perception and production of colours in drawings by non-artists. In order to explore aesthetic questions we need to examine the effect of colour use by artists. A preliminary study of digital images of Picasso's paintings (Humphrey, Lucyk & Purchase 2014) suggests that while Picasso's work was dominated by specific colour ranges during specific periods of his work, the colours were related to emotions perceived by observers as shown in the descriptors used by these observers. The findings need to be validated with observations of the actual paintings, as colour reproduction varies a great deal between digital images and the original paintings. The experience of artworks in a gallery and on digital screens of various sizes varies considerably. Colour, as part of those experiences, needs to be explored further.

7 References

- Baxter, E. (2007). The meaning of colour in drawings. Honors Thesis King's University College at The University of Western Ontario.
- Dupuis, T (2012). Preference for building style and colour. Honors Thesis Department of Psychology, King's University College at The University of Western Ontario.
- Eves, J. (2015, November 26). A tabletop for precocious Picassos. *Toronto Globe and Mail*.
- Garrison, K. (2012). Effects of colour on performance and emotional associations. Honors Thesis Department of Psychology, King's University College at The University of Western Ontario.
- Humphrey, D., Lucyk, B., Purchase, C., and Vandewiel, T. (2015, March). Perception of intentions in emotional drawings by elderly and younger non-artists. Poster presented at Rotman Research Institute Conference, Toronto.
- Humphrey, D., Lucyk, B., & Purchase, C. (2014). Picasso's expressive use of colour in paintings. *Proceedings of the XXIII International Association of empirical Aesthetics*. New York.

Humphrey, N. (2006). *Seeing red. A study in consciousness*. Cambridge, MA. Harvard University Press.

Lucyk, B. (2014). *Colour and emotional intensity*. Honors Thesis Department of Psychology, King's University College at The University of Western Ontario.

Lucyk, B., Purchase, C. & Humphrey, D. (2014, July). *Colour and emotion in drawings*. Poster presented at the Canadian Society for Brain, Behaviour and Cognitive Science. Toronto.

Maurer, D., Gibson, L.C. & Spector, F. (2013). *Synesthesia in infants and very young children*. In J. Simner & E. Hubbard (Eds.) *Oxford Handbook of Synesthesia*. Oxford: Oxford University Press.

Palmer, S. & Schloss, K. (2010). *An ecological valence theory of human color preference*. *Proceedings of the National Academy of Science of the United States of America*. 107, 8877-8882.

Pixar Animation Studios (2015). *"Inside Out"* Film released by Walt Disney Pictures.

Purchase, C. (2014). *Subjective emotion and colour use in drawings*. Honors Thesis Department of Psychology, King's University College at The University of Western Ontario.

Ramachandran, V.S. & Hubbard, E.M. (2006). *Synesthesia; What does it tell us about the emergence of qualia, metaphor, abstract thought and language?* In J.L. van Hemen and T.J. Sejnowski (Eds.) *23 problems in systems neuroscience*. New York: Oxford University Press.

Simner, J. (2013). *The "rules" of synesthesia*. In J Simner & E. Hubbard (Eds.) *Oxford Handbook of Synesthesia*. Oxford: Oxford University Press.

Willits, E. (2007). *Environmental colour and self-disclosure*. Honors Thesis Department of Psychology, King's University College at The University of Western Ontario.

Views of the Brain: Descartes, Willis, and Hogarth

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Abstract

Case studies, particularly comparative analyses within specific cultural paradigms, allow us to see the bootstrapping process in terms of contextual and situational developments that fostered it. This process, or how we use the knowledge base we have to build a more robust understanding, is the concern of this paper. Here scientific and philosophical bootstrapping histories are coupled with broader cultural commentary. The discussion primarily critiques competing views of the brain proposed by the philosopher René Descartes (1596–1650), “The Father of Modern Philosophy,” and the physician/experimentalist Thomas Willis (1621–1675), “The Father of Modern Neuroscience.” William Hogarth’s (1697–1764) artwork places these ideas within the artistic, humanistic, and sociological purview. Although Hogarth’s work covers a broad spectrum, this brief paper only examines his *Credulity, Superstition and Fanaticism* (1761), which includes an image of *The Willis Brain*, originally drawn by Christopher Wren.

Keywords history of neuroscience, philosophy of mind, brain, history of science, art history, british history

Introduction

When we look at epochs comparatively we find both commonalities and

incongruities. For example, the physician Hippocrates (c. 460–c. 370 BC), a contemporary of Plato (c. 427–347 BC), wrote in *On Sacred Disease*:

[Humans] ought to know that from nothing else but the brain come joys, delights, laughter, and sports, and sorrows, griefs, despondency, and lamentations. And by this, in an especial manner, we acquire wisdom and knowledge, and see and hear and know what are foul and what are fair, what are bad and what are good, what are sweet, and what are savory.... And by the same organ we become mad and delirious, and fears and terrors assail us.... All of these things we endure from the brain (Hippocrates 400 BC).

The perspicacity of Hippocrates' insights belie that significantly less was known about the brain, human anatomy, and human physiology in Ancient Greece. Indeed, his statement is particularly remarkable in light of the limited tools at his disposal relative to the armamentarium of our time. Even more compelling is that despite our more robust technological sophistication we have not resolved basic questions like individual cognition and mind/brain connectivity. Nor can we approach an explanation of the diversity of individuals within and among cultures. How the personal and interpersonal are connected is similarly open to debate.

When we look at specific topics, for example electricity, our perspective on the knowns and unknowns is equally striking. Today we know that minute electric signals flowing within the electric circuits of our nervous systems are operative processes when we look at a beautiful landscape or listen to music, when we express emotion, and when we ponder new information. The word “now” is the definitive referent here because knowledge of the electrical circuits of our nervous system was only perceived with Luigi Galvani's (1737–1798) discovery of animal electricity at the end of the 18th century. This level of information was thus unavailable to those who contributed to our knowledge base prior to his insights. Moreover, although, Galvani's work was nonetheless an important first step toward the modern understanding of the electrical basis of neural activity, he was unaware of the nuances of brain chemistry that were later discoveries.

Case studies, particularly comparative analyses within specific cultural paradigms, allow us to see the bootstrapping process in terms of its contextual and situational development. This process, or how we use the knowledge base we have to build a more robust understanding, is the concern of this paper. Here scientific and philosophical bootstrapping histories are coupled with broader cultural commentary. The discussion primarily critiques competing views of the brain proposed by the philosopher René Descartes (1596–1650), “The Father of Modern Philosophy,” and the physician/experimentalist Thomas Willis (1621–1675), “The Father of Modern Neuroscience.” At that time, many were beginning to look outward at nature’s operations in order to gain a greater understanding of God, the Creator, through the physical world and our experiences within it. William Hogarth’s (1697–1764) artwork places these ideas within the artistic, humanistic, and sociological purview. Although Hogarth’s work covers a broad spectrum, this brief paper is only concerned with *Credulity, Superstition and Fanaticism* (1761), which includes an image of *The Willis Brain*, originally drawn by Christopher Wren.

Neuropsychology: Mind and Body

Turning first to Descartes and Willis, we find both men challenged older theological and Scholastic teachings, rejected a number of long-standing fallacies, and opened innovative means of investigation. Both also turned to hands-on dissection studies to aid them in their studies of the brain, the mind, and the nervous system. More significantly, although Descartes’ work is largely cited today as the foundation of psychological theories related to the brain, the mind, and the body, this kind of abbreviated history omits that Willis, an experimentalist, searched for biologically based connections within the theological framework of their shared paradigm. It also oversimplifies the rich debates among early neuropsychologists like Descartes and Willis historically.

While I characterized Descartes and Willis as a philosopher and a physician/experimentalist earlier, they identified as natural philosophers. This was the term then used for both experimental scientists and discursive philosophers.

We also know that their foundational assumptions included a theological component because the abiding premise at that time was that God had created the biological processes that were the driving force of the machinery in the bodies of both humans and animals. In terms of the mind/brain/body problem, there were two prevailing ways of wrestling with the landscape. One was to ask what was the best approach for ascertaining how God had connected the body and the soul. Researchers also asked how the brain, the mind, and the body are involved in sense perception.

As is the case today, lively discussions ensued. A major difference between the two earlier views and contemporary investigation is the degree to which the nature of the soul accompanied these earlier explorations of the mind and brain mechanics. To oversimplify, a major issue then was *how God* connected the body and mind/soul. Within this, a predominant concern was whether matter was in itself active or passively mechanistic (inactive).

René Descartes, the “Father of Modern Philosophy,” saw matter as mechanistic (inactive) and this led him to embrace the mind rather than what he saw as passively mechanistic matter. Employing a strategy of skepticism and doubt, he posed broadly-based questions in his effort to explain how the body and soul communicate: When we make a moral judgment, it can change our actions, but how? Does doubting one exists serve as a proof of one’s existence?

While we thus reject all of which we can entertain the smallest doubt, and even imagine that it is false, we easily indeed suppose that there is neither God, nor sky, nor bodies, and that we ourselves even have neither hands nor feet, nor, finally, a body; but we cannot in the same way suppose that we are not while we doubt of the truth of these things; for there is a repugnance in conceiving that what thinks does not exist at the very time when it thinks. Accordingly, the knowledge, *I think, therefore I am* [*cogito ergo sum*], is the first and most certain of which occurs to one who philosophizes in an orderly way (Descartes 1644: Part I, Article 7).

When Descartes proposed that mind and soul are interchangeable he was hypothesizing that they comprised a single entity, “the rational soul,” with the body being comprised of another substance. The pineal gland provided connectivity. His idea of separate substances included the supposition that the bodies of humans and animals essentially function similarly in many ways, and yet humans differ from animals. To his mind, the point that needed clarification was how mind and body operations in humans happened since, again, to his mind, animals did not have a consciousness comparable to human consciousness: they were automata without souls.

Thomas Willis, the “Father of Neurology,” by contrast, was convinced that matter is active. He based his conclusions on his work as a physician and his knowledge of animals. He held that animals, like humans, could acquire knowledge and therefore, unlike Descartes who concluded animals lived without souls, Willis believed that animals did indeed have mortal, material souls that encompassed their nerves and brains — and humans were “double-soul’d animals.” (Zimmer 2004: 217). In other words, Willis believed God endowed humans with a rational soul that determined right and wrong in the healthy body through reason. There is a vital soul that came from the heart, a sensitive material soul that arose from the vital soul, and an immortal rational soul for higher thought that came from the head. Though immaterial, the immortal soul operated on the brain.

Willis sought clues on mind body operations through his ongoing anatomical explorations rather than probing philosophical questions. For this reason, some conclude that his laboratory investigations ushered in a new era in experimental neuroscience. In his groundbreaking *Cerebri Anatome* Willis explains how he approached his research:

I determined with my self seriously to enter presently upon a new course, and to rely on this one thing, not to pin my faith on the received Opinions of others, nor on the suspicions and guesses of my own mind, but for the future to believe Nature and ocular demonstrations: Therefore thenceforward I betook my self wholly to the study of Anatomy: and as I did chiefly inquire into the

offices and uses of the Brain and its nervous Appendix, I addicted my self to the opening of Heads...and so a firm and stable Basis might be laid, on which not only a more certain Physiologie than I had gained in the Schools, but what I had long thought upon, the Pathologie of the Brain and nervous stock, might be built (Willis 1664/1978: 54).

Willis' laboratory work and clinical insights were aided by a new medical chemistry and an array of other innovative tools developed by him and his collaborators as they explored disorders of the brain with more specificity than in earlier eras. Initial results were recorded in his remarkably successful *Cerebri Anatome* (1664), the first publication to describe many neurologic and psychiatric disorders. Willis' *Two Discourses Concerning the Soul of Brutes* (1672), a later book, is seen as the first contribution to neuropsychiatry.

Innovation and Visualization in the Broader Context

Despite their methodological differences, both Descartes and Willis brought creative thinking to their endeavors. Descartes' innovations and accomplishments were in the mental and mathematical realms. He invented the Cartesian coordinate system and the analytic geometry that led to the invention of the Calculus. His Cartesian doubt served as a conceptual challenge to the dialectical rigor of the Scholastic thinkers, one that added new, skeptical, and speculative questions to the methodology. Descartes in effect moved the focus of the metaphysical Scholastic stance while retaining its conceptual rigor in addressing philosophical problems. The mental twists he added led to later problems in defining human subjectivity within the scientific landscape, as discussed in more detail below (also see Ione 2016). Suffice it to say that Descartes' revolutionary questions expanded the traditional philosopher's toolbox. It did not replace it.

Descartes' *cogito* argument clearly distinguishes his goals from those of an experimentalist like Willis because it shows how he centered his inquiry within his mind — asking what knowledge is and what it means to doubt

one's own existence. More broadly, and to oversimplify, Descartes "rational soul" and his conception of a "mechanistic universe" offered a dualistic framework that he struggled to fully clarify over the course of his life. Indeed, some of his later views cut against the grain of how we commonly define his legacy. For example, his debates with Princess Elizabeth of Bohemia about his interactionism (mind-body) thesis offer a good case in point on how dialogue refines an individual's ideas as colleagues and communities critique one another's arguments (see Ione 2016).

We also know that Descartes' thinking was quite radical in its time. For example, he worked on the *The Treatise on Man (De Homine)* in the early 1630s, but decided not to publish it on hearing of the condemnation of Galileo in 1633. The book first appeared in Latin translation in 1642, in the original French in 1644, and the Latin version was again published posthumously in 1662. Whatever the reason for the publication's delay, it is commonly said that the church did not attack Descartes' published mechanistic philosophy more than it did because he excluded the immortal soul from the realm of the body. In other words, he did cause some umbrage, but his investigations of the mind and body sufficiently avoided dicey ideas like salvation and transcendence.

Thomas Willis, by contrast, operated as a Royalist physician during the English Civil War. Despite the clinical focus of his *Cerebri Anatome* (1644), it is fully seasoned with religious and Royalist metaphors that serve to elevate God and the monarchy. We see this when he defines the brain as a "kingdom" and the capital of the empire. Similarly, phrases like the "Chapel of the Deity," celebrate God's supremacy — even as Willis gives full attention to functional and anatomical elements. An experimentalist, he proposed that perception, movement, cognition, and memory are all functions of the brain substance. The cerebellum is defined broadly and said to mediate the vital and involuntary systems in contrast to the higher functions. He also postulated that imagination is tied to the cerebral hemispheres and suggested the corpus striatum played a more basic role in sensation and movement. In terms of every era's efforts to define concepts like creativity, it is noteworthy that he and other early neuroanatomists retained qualities like

fantasia and imagination in their studies.

Willis' research, like Descartes', operated within a larger sphere. The Oxford group or *Virtuosi* with whom Willis worked included Thomas Millington (1621–1675), Robert Hooke (1625–1703), Richard Lower (1631–1691), Robert Boyle (1627–1691), Christopher Wren (1632–1723), John Locke (1632–1704), and others. (Many members of this group became founding members of the Royal Society.) This group's efforts, like Descartes' conversations with Princess Elizabeth of Bohemia, remind us that communication and collaborative efforts contribute to and refine inquiry.

For example, one of Willis' goals was to produce an analysis of the arteries of the brain using William Harvey's (1578–1657) views on blood circulation as his model. Christopher Wren, now better known for his architectural feats, contributed exquisite drawings (Fig. 1) that show Willis ultimately achieved his objective with great skill. The dissections were done after pumping dye into the carotid arteries of animal and human specimens in order to imitate the natural flow of blood (Flis 2012). Then a tool Wren devised allowed him to trace the topography of the brain, although he does not present a photographic sense of any brain they saw. Rather he portrayed a synthesis of what Willis and his collaborators had learned about the structure of the brain over a period of time in which they studied numerous organs.

Other innovations and related discoveries contributed as well. Briefly, after Boyle deduced that immersion in pure alcohol would halt the process of decay, researchers could work with a brain for as long as they wished and study it slowly, using microscopic devices also developed at this time. Wren's similarly innovative etchings were produced with an acid process that was an emerging form for book illustration in England at that time (Flis 2012). The sum total comprehensively demonstrates how broadly changes in knowledge practices extend outward.

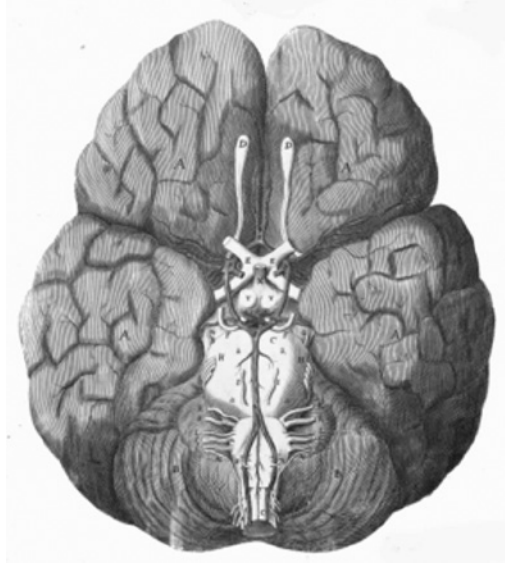


Fig. 1. *The Willis Brain*. (*Cerebri anatome*, 1644).

As noted, Willis and Descartes were quite in line with virtually all scientists of their day and for almost two centuries afterward in assuming a *theological* soul that has physiologic functions. This premise was largely changed by the 19th century through experimental research and Darwinism. With the gradual acceptance of the idea that the human nervous system is fully a biological system mind/brain investigations assumed another texture. What is key here is that the fusion did not reconcile the nature of mind and body connections. Rather, it separated the mind from the soul. Thus, precisely how the mind and the body work together remains an outstanding question, as is the question of how our minds and bodies interact communally.

If the elevation of biological explanations caused Descartes' dualism to lose some of its adhesion, so did the increasing cultural secularization and redefinition of "mechanism" once industrial machinery entered the picture. As philosophy severed its spiritual core, Descartes work was no longer explained in theological terms because "spirit" and "soul" were moved to a lesser position within the methodology. Of course, the methodological approach to brain research shifted with the philosophical terrain. So,

whereas Willis and Descartes *each* brought a unique vantage point to their studies, both were nonetheless operating within a “religious,” pre-Darwinian sensibility. When we examine their views in tandem and retrospectively it is nonetheless easy to see how “natural philosophy” will morph into two approaches: science and philosophy.

William Hogarth: The Brain Within the Cultural Paradigm

A particularly astute commentary showing scientific ideas within the broader cultural conversation is William Hogarth’s (1697–1764) *Credulity, Superstition and Fanaticism* (1761). This satirical print ridicules secular and religious credulity, and lampoons the exaggerated religious “enthusiasm” (excessive emotion) of the Methodist movement. Hogarth’s work is frequently described as replete with commentary on moral dilemmas and great skepticism toward medical professionals. This conclusion overlooks that many of the people he caricatured were friends and professional colleagues. We see his interest in science through the scientific ideas and devices he incorporates into his work.



Fig. 2. *Credulity, Superstition and Fanaticism. A Medley*. William Hogarth. 1762.

Credulity was actually derived from an earlier print, *Enthusiasm Delineated* (1760). Both allude to the *Willis Brain*, (on the lower right), with a thermometer that measure emotions and passions extending out of the organ (Figs 2, 3). We know it is a brain because the first print includes a hand written notation that makes the association, citing the Human Brain as the true Dwelling Place of the Holy Spirit (Krysmanski 1998). Hogarth adds social commentary, using the brain and thermometer to convey it is monitoring the emotions and human passions of the Methodist congregation gathering to hear the preacher elevated above them.

Both prints depict the brain sitting upright on its cerebellum with *Credulity* showing it cushioned on Joseph Glanvill's treatise on witches (used to justify the Salem trials) and John Wesley's Sermons. Listening to the preacher with an ear attached by a single auditory nerve, the brain is a warning not to believe all we hear — lest it go directly to our heads. Hogarth's linking of an emotionally laden image, replete with religious, moral, and scientific commentary meshes well with that time's prevailing ideas about God as the Creator (discussed above).

Just as Willis tied morality and the rational soul to his view of mental health and human psychology, Hogarth does as well. He ties the printed brain to the preacher's audience through having the thermometer measure a range of intense moods in increments called agony, despair, lust, etc. The use of *The Willis Brain* additionally emphasizes the degree to which Willis' experimental focus was tied to religion (although it differed from the more internalized subjectivity of Descartes) as well as the complexity of human life. As Zimmer explains it:

Hogarth's brain also sprouts a thermometer from its frontal poles — another icon of the scientific revolution, representing objective measurement over subjective judgment. Its scale does not measure degrees of heat, but degrees of madness, running from the melancholy low of suicide and despair to the manic highs of lust, ecstasy, and convulsions (Zimmer 2004: 286).



Fig. 3. Above, *The Willis Brain*. Right: Thermometer detail from Hogarth's *Credulity, Superstition and Fanaticism. A Medley*

Conclusion

Debates about the mind, the brain, and the nervous system are lively in every paradigm. If Descartes' theories are now foundational within the philosophy of mind trajectory, Willis' experimental work reminds us that experimentalists and clinicians were actively involved with biological inquiries throughout history, even as they flavored their discoveries in the terms of their cultural biases. Earlier work also reminds us that the oldest methods we have for studying the brain are anatomical. Descartes, to be sure, was more focused on a methodology that grappled with ideas about knowledge (epistemology) and being (ontology) than anatomy *per se*. Nonetheless, he did hands-on studies — dissections — to learn more about brain/body operations. Willis, as noted, employed a biological emphasis on structural research in his clinical research, seeing it as a means to celebrate God's design.

Comparing Willis and Descartes additionally shows that the idea of “one” prevailing paradigm obscures how complicated investigations are in each epoch. Willis’ contributions, strangely, are not as widely recognized today as a part of the historical package within discussions of the mind and brain. Moreover, as noted, if Descartes subjective questions began to move the study of the mind outside the realm of experimental science, later when later experimentalists and philosophers developed tactics for integration, the questions of how to handle subjective qualities experimentally remained.

Christopher Wren’s illustrations for Willis’ book, while not fully discussed here, demonstrate the degree to which visual imagery was a part of investigations, as do the schema in Fig 4. Hogarth’s visual commentary further captures the range of contextual nuances that were built around mind/brain assumptions.



Fig. 4. Views of the Brain: Left: Woodcut of head showing Cerebral ventricles, Published: 1503. Left Center: Vesalius, Plate 67 from the *Fabrica* (1543). Right Center: Left: *The Willis Brain, Cerebri anatome* (1644). Right: fMRI scan (2000).

Although beyond the scope of this paper, the rich historical revision brought about with the publication of *The Origin of Species* by Charles Darwin (1859) deserves a few words. Darwin’s evolutionary theories gradually replaced theological foundations with the idea that the human nervous system is fully a biological system. In the 19th century we also find that the fusion of the mind (brain) with the biological body did not come about through research that precisely combined mind/brain mechanics and body operations. Rather, it was one that separated the mind from modalities formerly framed in terms of the (rational) soul. Precisely how the mind and the body work together remains an outstanding question. In part this stems

from the difficulty in capturing this complex terrain experimentally. Evasive areas include creativity, ethics, and humanistic concerns. As our scientific research models incorporate more ideas about plasticity and genetic variation it is likely that we will in time conceive the kind of flexible model that Darwinian evolution infers, although I am of the opinion that we will never fill in all of the details.

That said, a most interesting wrinkle within our views of the brain is how our ideas are bantered about. A part of the allure of science today comes from the way scientists test their theoretical claims and present their conclusions about internal processes interpersonally. In terms of their inquiries on the brain and cognition, we find that experimental evidence is not shared or debated within the “brain space” as if it exists alone, detached from our bodies and situational environment. Both Descartes conversations and those of Willis showed this as well. Therefore, even if convincing experiments simplify parameters about how the brain in our heads operates, characterizing science as a reductive body of established facts that reduce the world to this or that skews the interchange etched within its communication process. This characterization similarly removes the measure of creativity and passion many — like Descartes and Willis — bring to their work.

Today, our knowledge of paradigmatic change has shown us that neither science nor philosophy provides a full or infallible story about life and nature, despite their worthwhile contributions. To be sure, scientific insights are seductive precisely because the methodology seeks evidence that is convincing within the communal space. Yet, even as scientific design includes both replication and falsification, its results are often embellished with unverifiable theoretical or philosophical pronouncements. Both Descartes and Willis remind us of this, as they remind us that the tension between what we know and how we can learn more enriches our lives.

Acknowledgements: The fMRI scan used in Fig. 4 is courtesy of Robert N. Beck. All other images are courtesy of the Wellcome Image Library and made available under Creative Commons Attribution only licence CC BY 4.0 <http://creativecommons.org/licenses/by/4.0/>

References

- Darwin, Charles. 1859. *On the Origin of Species by Means of Natural Selection*. London,: J. Murray.
- Descartes, René. 1644/1901. *Selections from the Principles of Philosophy (Project Gutenberg)*. Translated by Veitch, John. Munich: C. H. Beck.
- Flis, Nathan. 2012. "Drawing, Etching, and Experiment in Christopher Wren's Figure of the Brain." *Interdisciplinary Science Reviews no. 37*:145–160.
- Hippocrates. *On the Sacred Disease* (The Internet Classics Archive) ~400 BCE. Available from <http://classics.mit.edu/Hippocrates/sacred.html>.
- Ione, Amy. 2016. *Art and the Brain: Embodiment, Plasticity, and the Unclosed Circle*. Amsterdam: Rodopi Brill.
- Vesalius, Andreas. 1543. *De Humani Corporis Fabrica Libri Septem*. Basileae [Basel]: Ex officina Basileae [Basel]: Ex officina Joannis Oporini.
- Willis, Thomas. 1664/1978. *The Anatomy of the Brain and Nerves (Tercentenary Edition, 1664–1964)*. Edited by Feindel, W. Birmingham, AL: Classics of Medicine Library.
- Zimmer, Carl. 2004. *Soul Made Flesh: The Discovery of the Brain—and How it Changed the World*. New York: Free Press.

Empathy. Mimicry. Touch.

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Abstract

Throughout this paper the key themes of Empathy, Mimicry and Touch will be contextualised through research supporting a project that concerns itself with achieving a critical understanding of the placement of expressive movement in the development of a creative intervention for autistic children. The research presented reflects on literature connected to psychology and the study of childhood development to address the concerns around complex empathetic understanding for those on the autistic spectrum. This literature will also give comprehension for the placement of mimicry in the development of empathetic relationships, and how mimicry is used throughout the process of childhood development, and language acquisition. The latter part of the discussion will focus on the position many UK schools take on the inclusion of touch between adult and child within their institutions and the argument for the need of touch when facilitating and supporting the development of social interactions. Throughout the conversation on touch there will be reflections on how touch is used in creative environments such as Dance and Movement training, and how we might draw on this use of touch in a creative setting for children who exhibit social and communicative impairments. The wider conversation here is concerned with the use of technology in the school setting and the effect of using technologies that are often designed for the conventional, solo, user, when social skills are underdeveloped, as in the case of autistic children. This will be contextualised within the discussion of Empathy, Mimicry and Touch to comprehend

how a more collaborative and creative approach to the use of technology in a school environment for the autistic child, might help, not hinder, social experiences and communicative engagement.

Keywords autism, developmental disorders, empathy, mimicry, social interaction, touch

Introduction

This project aligns with research suggesting that the autistic child has an increased affiliation with new technologies, as they are introduced into their daily life. The position this research takes in this discussion brings to light a chance to refresh the relationships with technologies that are often designed for the conventional, solo, user, by applying an analytic understanding of audio-visual technology in the form of digital mediation. This is done so through the use of live feed footage projected into the space where the interactions are taking place, allowing a social experience to be encouraged alongside the interaction with technology. As Dr Wendy Keay-Bright has said about a project using technology alongside Interactive Play, ‘the value of this approach is that it shifts the focus away from the functional demands of the technology towards encouraging users to explore, create and communicate through the actions they perform’ (Keay-Bright, 2008: 8), which is how the use of technology in this project should be considered. The danger is that the technology proceeds the child’s needs, as pointed out by Keay-Bright and Howarth: ‘[...] the majority of research into autism and technology focuses on how the skills of already high-functioning children might be improved upon, but there is a paucity of literature addressing the needs of children with more significant difficulties’ (Keay-Bright & Howarth, 2012: 130). This project is concerned with the development of an approach to technology that primarily amplifies and extends the possibilities for autistic children, in addition to their everyday school experiences.

Situated in a research project that gives focus to achieving a critical understanding of the placement of expressive movement in the development of a creative intervention for autistic children, there are three key principles to

introduce, that underpin this investigation: Empathy, Mimicry and Touch. This idea is advanced by the proposition of using technology, as a form of mediation, in this setting is particularly significant when connecting research surrounding the heightened affiliation with technology, evidenced by a large percentage of autistic children. The research itself aims to inform the discussion, and literature, surrounding autism and the use of current technologically enhanced interventions by addressing the need for this to be combined with social experiences. The way in which audio-visual technology is being applied in this paper is to situate this work within the extended research for this project, as a whole, whilst also highlighting the need for balance between human interaction and technological engagement in and an intervention specifically for autistic children. Yet, it is the need for a comprehensive knowledge about the ability to develop social and communicative skill through the combined application of the three principles, in a development of an intervention for autistic children that is being presented to you here. Once these core principles are established and understood, the use of technology further enhances their social, experiential, knowledge, rather than further isolate the child through solo engagement with technologies, which may cause a plateau, or decrease, in social and communicative development.

When considering the diagnosis of autism, which specifies difficulties in the development of social interaction, communication and imagination, it is clear that this *Triad of Impairments* needs to be taken into consideration. The sessions being facilitated for the larger research project that this discussion is a product of, which provides one-to-one interactions that emphasise the importance that an experienced movement practitioner, with a Dance background, can offer in this practical environment. In the facilitation a combination of mimicry and imitation were applied when developing this innovative tool, as they both offer an experience of developing trust in the relationship between participant and facilitator, which will begin to enable empathetic understanding in this setting. The aim here is also to create a setting in which the child feels able to explore, and potentially develop, their social and communicative skills. This is due to the process supporting the child's experiential understanding of the self and other - self-referential

ability - as research suggests that 'self-referential cognition and empathy are inextricably linked' (Lombardo, et al., 2007).

The use of mimicry was an idea evidenced through personal influences from movement practices well known and appreciated in Dance and Movement training, such as *Contact Improvisation*. *Contact Improvisation*, as a principle, promotes a reflexive engagement with the ideas it presents, allowing the facilitation process to appreciate a higher level of comprehension into the importance of having a considered theoretical understanding of the body and self-developmental principles when pursuing the primary research with the participants. It also offers the chance to create an environment individual to each child participating, by encouraging improvisation a way to promote non-prescriptive facilitation. This also gives purpose and attention to the benefits of the process of engagement itself, rather than deciding what should be the end behavioural goal. By using the movement sessions as a method in this research project the influences from the movement practices offer a complimentary appreciation of mimicry as access to empathy, as a core concern key theme.

Empathy

Throughout the diagnosis it is thought that all people with autism lack empathetic understanding, but Simon Baron-Cohen describes this as a myth, stating that the spectrum of autism is too broad to be able to make a generalised statement about the specifics for each individual with the diagnosis. Yet, he begins to make some distinctions:

However, I've met hundreds of them over my career and my experience tells me that whilst most people with autism struggle with the cognitive aspect of empathy (also known as 'theory of mind'), most have intact if not well-developed levels of affective empathy (caring about others, and wanting to alleviate their suffering). (Baron-Cohen, 2014: 800)

Here he suggests that the cognitive understanding, which will be described in this essay as complex empathetic understanding, is often limited, except

when social understanding is developed, as those who are more developed socially evidence the empathetic responses to others. This idea is also drawn upon by Carol M. Davis in her article *What is Empathy, and Can it Be Taught* (1990), where she comes to the conclusion that it cannot be taught, but is intrinsically linked to social understanding, and develops into a complex empathetic understanding, through the teenage years. 'Empathy seems to be a communication process that develops as we mature. Cognitively and emotionally mature people should be capable of experiencing empathy' (Davis, 1990; 35). Therefore, if the autistic child has underdeveloped cognitive abilities as a result of their diagnosis, limited complex empathetic understanding is often evidenced. These ideas are important for this particular research project, as the group of children participating in the primary research have been highlighted as having a cognitive developmental age much lower than their chronological age.

When considering the idea surrounding the need for maturity, as Davis describes it, it is important to address the need for an understanding about the self and other in this process. This allows focus to shift to the embodiment of empathy and how this aligns with the sociability of humans, and primates alike. The embodied social instinct exhibited from birth has a comprehensive body of literature surrounding it, but suggests that those with neuro-typical development have an embedded need for social experiences, and through this complex empathetic understandings are developed. In Thompson's text *Empathy and Consciousness* (2001) he quotes the work of Janet Wilde Astington to explain that 'between the ages of two to five, children begin to be able to interpret themselves and others in human psychological framework of thoughts, feelings, beliefs, desires and perceptions' (Astington, 1993 in Thompson, 2001).

Mimicry

It is also through the literature supporting early childhood development that the process of mimicry is emphasised as an important feature through this important developmental period and it is through this vital progression that the idea of self and other is becoming increasingly refined.

Mimicry and the imaginative transposition of oneself to the place of the other are no doubt elements of empathy, but they are founded on more fundamental pre-reflective couplings of self and other at the level of the lived body: it is the passive (non voluntarily initiated), pre-reflective experience of the other as an embodied being like oneself that sets the stage, as it were, for mimicry and the more elaborate mental act of imaginative self-transposal. (Thompson, 2001: 12)

This understanding allows the connection between the childhood development of neuro-typical children and position of mimicry in this process to be comprehended and connected to ideas of self and other in the conversation of empathy, and more so the need for self referential abilities to assist in this developmental process. Therefore it is clear that the position of mimicry coming into focus as the second of these three key principles. After all, as Thompson (2001) citing Goldman endorses the idea that ‘Empathy, on this view, is a special case of mental simulation, in which the output states are affective or emotional states: empathy consists of a sort of “mimicking” of one person’s affective state by that of another’ (Goldman, 1995 in Thompson, 2001).

The research surrounding Empathy connects strongly with literature discussing the processes of language acquisition throughout childhood development, and for this investigation it is vital to acknowledge the involvement of gestural communication. All communication consists of elements that are both verbal and non verbal, and to have the ability to read this there is, again, a need for an understanding of the self and other, along with maturity of social understanding. When beginning to connect and understand the self and other in the conversation of developed complex empathetic understanding the following concept was explored:

This concept is interesting, in its connection to the understanding of empathy and neuro-typical development from a self-referential view point, in combination with childhood imitation as a development tool. [...] it is understood that by using kinesthetic and proprioceptive awareness to understand one’s own body, and the bodies an individual

interacts with, it is possible to develop a complex level of empathy. (Jackson, 2014: 209)

Through this more thorough understanding of the association between mimicry and complex empathetic understanding it was clear that these two elements were more than just aligning in the research supporting this project, they were intrinsically connected. This research has also shown that there are “several ways that self-referential cognition and empathy are inextricably linked” (Lombardo, et al., 2007). This was an exciting discovery for a research project that began as a process of exploring ones intuitive responses to autistic children, and is now supported by the research is evidencing the importance of the practice.

Touch

The final component of this investigation is Touch, and by introducing the theme of Touch here, the intention is to address this need, that Thompson describes, supporting the ability to understand the physicality of the body, and other bodies, and objects, a like.

This experiential grasp of inter-subjective space is a condition of possibility of one’s ability to experience one’s own living body as a physical body like other physical things in the world. If one were confined to one’s own first-person point of view such that one had absolutely no empathic openness to other (an impossibility because of the open inter-subjectivity of consciousness), and hence to how one would be experienced by another (empathy as the experience of myself as being an other for you), one would be incapable of grasping that one’s own body in physical object equivalent to the other physical things one perceives. (Thompson, 2001: 19)

With touch playing such a large part in the childhood development of neuro-typical children, and its interchangeable with mimicry in this process, it seems obvious that it is an importance piece of the larger network of research.

Within the diagnosis of autism the *Triad of Impairments* can present it self in many different ways individual to the child holding the diagnosis. Yet, often present is some amount of sensory impairment that may be evidenced in their visual or auditory receptors or could be through tactile sensations including physical touch of another human or animal, clothing, food, heat, etc. “Sensory functioning is recognised to be different for children with autism” (Cullen, Barlow & Cushway, 2005: 183), and for this discussion I will be focusing on the sense of touch. Throughout literature on childhood development it is clear that the sensation of touch is more important, in early development, than vision and hearing, so we need to stress that those who resist or find discomfort in touch, at a young age, are likely to have remain with this experience throughout their adult life, if a positive association with touch is not reached. This is most clearly articulated by Cullen, Barlow & Cushway:

Understanding more about the role of the senses for children with autism may help identify avenues for learning and skill development previously unexplored.

Touch provides the first sensory input in life while a baby is still in the womb and continues to play an important part of how children learn about the world as well as being essential for children’s healthy grown and development. Children with autism may be aversive to, and avoidant of, touch, they may also be hyper or hypo sensitive to touch and may display tactile defensiveness in the form of rubbing, scratching, withdrawal and negative expressions. (Cullen, Barlow & Cushway, 2005: 183)

A difficult obstacle in this discussion is that many schools, and similar institutions, especially in the UK, have become wary in recent years, of using any kind of touch within their interactions between teacher and pupil/ adult and child. This arises from a fear that touch is too quickly regarded as something unnecessary in such a setting, and as a consequence may be interpreted as inappropriate in the first instant, without assessing the need for touch in many situations when dealing with the emotions of a child. This is particularly important to consider when interacting with children who pres-

ent a negative response to touch, and the effects this can have on not only their development, but also their ability to gain social understandings about the use of touch between peers, family, and members of authority. As Lord addresses this, he makes clear that this is not an insignificant issue:

This poses a dilemma as many children we teach seem to find being held or touched highly distressing and avoid contact wherever possible. There may be understandable reasons for this as unpredictable and uncontrolled human contact has been described as frightening and confusing by people with autism. There may also be underlying sensory and motor disturbance that contribute to the avoidance of personal contact. (Lord, 1997: 85)

Yet, if this avoidance is accepted early on, and not positively challenged as part of their developments socially, then this could continue to present itself in later life. Due to this I believe, if working to assist an autistic child's developed social and communicative understanding, the adults in that setting cannot avoid the use of touch; it needs to be embraced as an element of the majority of the social aspects of life. The following statement from Dr Dave Hewett, who founded a technique called *Intensive Interaction* alongside Melanie Nind in the 1980s, aligns clearly with the reasons for incorporating touch in the primary research for this project.

I certainly intend it to combat any arguments such as 'we can't use physical contact because it is not appropriate/could be abuse/too risky/what will people think/could be misconstrued, etc. I will try to make clear that using touch is totally and utterly appropriate. (Hewett, 2007: 117)

Intensive Interaction is a practical approach was developed to encourage and enhance meaningful communication with those who have learning difficulties. It is aimed at, and appropriate for, a variety of people with diverse abilities and disabilities, but one of the common diagnosis it is used with is autism. It has been shown to work particularly well for those with a delay in social and communicative skills which is, more often than not, coupled

with, additional learning, behavioural, and/ or sensory needs, and therefore highlights touch as one of the most important principles throughout this intervention. “Thus, with physical contact as an essential aspect of these activities, there is the prospective essentiality of touch experience in early learning and particularly in communication learning” (Hewett, 2007: 120).

The research for this project, reported here, connects back to my experiences as a Movement Practitioner, with a Dance background, and for this section of the essay a conversation reintroducing of the principles *Contact Improvisation* is increasingly important. *Contact Improvisation* is a technique from the field of Dance practice but it's position here is reliant on the idea that it was developed to allow to people to interaction through improvisation, which connects to the principles of the one-to-one interactions for this project, and the discussion of touch within *Intensive Interaction*. The founder of *Contact Improvisation*, Steve Paxton, states that the process has to be in acknowledgement of the intentions of the individuals and how these should be at a minimal level, not a maximal, in order to encompass the intentions of the other. The shared experience, so often the minimal is more important than a maximal result for just one of the two people participating is stressed throughout this technique as well as the primary research of this project.

This system is based in the senses of touch and balance. The partners in the duet touch each other a lot, and it is through touching that the information about each other's movement is transmitted. They touch the floor and, three emphasis on constant awareness of gravity. They touch themselves, internally, and a concentration is maintained upon the whole body. (Paxton, 1975: 40)

The importance of touch within this technique is considered alongside a conversation about gaining knowledge about ones self and the world around them, which consists of the others in the space they inhabit, an idea that connects strongly to the discussions about self and other when considering the importance of mimicry and develop empathetic understanding. It is the aligning of arguments being presented here that acts as the main link between the three key principles of this paper. These key principles are

essential when comprehending the overall outcomes of a research project concerned with the development of an intervention that relies on an understanding of the importance of creativity and critically understand the expressive movement within this process.

Many of the children participating in the current primary research have been selected as their chronological age does not reflect their cognitive development, and the majority of the children have underdeveloped verbal communication skills (measured against neuro-typical development throughout childhood). The principles of *Contact Improvisation*, and *Intensive Interaction*, allow the nonverbal communication to be acknowledged more readily, which is supported by the interests in complex empathetic understanding, and the use of touch and mimicry with autistic children.

Moreover, in [*Contact Improvisation*] the sense of touch is more important than the sense of sight, which is the most widely-used sense in our everyday life. Communication will be based on this contact rather than on verbal and non-verbal communication signs, and social distance and organisational rules are re-structured, thus giving us an opportunity to analyse an activity that is not structured according to the most common cultural rules. (Torrents, Castaner, Dinusova, & Anguera, 2010: 55)

Contact Improvisation, in this research context, allows the facilitator to give focus to the individuality of autism, and create an improvised environment that allows authentic responses to the child, in the moment. This idea is supported by the need for an understanding of the other's body, and to be able to create an awareness of how your movement influence the other, and how they are influencing you. This is vital when creating a setting that is also concerned with mimicry as a core theme, an awareness of the self and other also promotes this connection through influence. Finally, *Contact Improvisation* provides a setting in which there are no present goals to be achieved, which connects with the concern that the child should be allowed this time to explore and play with communication and social interaction in a creative setting without developmental, or behavioural, goals being

applied to that child before beginning the sessions. This has a positive effect on the facilitator as it allows them to see the importance of improvisation in a setting working towards individual interactions with autistic children, on a one-to-one basis.

Conclusion

This research project is on going and the current focus is the primary research, which consists of the facilitation of one-to-one session with children with a diagnosis of autism. At present I am able to apply all of the techniques presented in this paper as a reflexive response to personal concerns about Empathy, Mimicry and Touch. The next step will be in to introduce the technological mediation into these interactions, in the form of live feed projections of footage filmed in real time during the interactions between facilitator and child. This proposes to give the child a social experience with technology, which is not designed for the conventional, solo, user, and therefore allowing an exploration of social skills in a creative setting. The interactions will also be filmed, as documentation, on multiple cameras throughout the duration of a 20-week period that this research spans, and this will assist the reflexive analysis of the interactions. The teaching staff at the school will also have involvement in this process, allowing their views of the environment created, and they Responses to that from the children, to be taken into consideration when beginning to analyse this process. Yet, in the mean time there are some provisional conclusions about the research to support these interactions.

When considering the research topic as a whole the primary research is clearly focused on the one-to-one interactions with autistic children, which are facilitated by a Movement Practitioner, with a Dance background. The intention for the project is to enhance knowledge around the placement of expressive movement in the development of a creative intervention for autistic children. The inclusion of Empathy, Mimicry and Touch in this discussion are given importance to allow an acknowledgement of need to explore the social developments of children who are increasingly affiliating with technologies designed for the conventional, solo, user. Each of the

three key principles presented in this paper are well understood through the literature surrounding the disciplines they sit within, most commonly psychology and childhood development, yet it is their position in this conversation about technology and autism that is the important connection being presented through this research.

The use of technology in this research project is applied by filming the interactions between facilitator and participant, and then projected this into the space in real time. The intentions behind this decision is to offer a second form of interaction for the children participating, other than the adult facilitating the session, as well as to enhance social experiential knowledge in combination with the engagement with technology. This idea initiated from a need to allow the affiliation with technology to be explored in a setting that encourages a social experience, as it offers an alternative from technological engagement only being a solo activity, particularly for children holding a diagnosis that makes them predisposed to to have social impairments.

Empathy is discussed here in combination with the conversations surrounding the importance of mimicry in childhood development, and focus upon more specifically in the progression towards complex empathetic understanding. Through this process the need for social understanding, maturity of social awareness, and a thorough understanding of the self and other were all highlighted as importance factors for empathy to be developed through childhood. This also gave awareness for reasons behind a lower empathetic understanding in many of those diagnosed with autism. The position of mimicry is important in the development of social skills as it is a tool that all children use to learn about the world around them, the others in it, and where they are position in comparison, as well as being prevalent in language acquisition – both verbal and non verbal. With this in mind it is clear that the these two key principles are intrinsically linked throughout the literature of psychology and childhood development, and shall also be present in this way throughout all of the research connected to this wider research project.

Embedded in this discussion is the use of touch and how it give focus and

attention to the need for physical contact through the process of learning about self and other. By learning about the physicality of ones own body, we are also enhancing our abilities' to understand the physicality of another's body, thus having a positive impact on the development complex empathetic understanding. With these three combined it is proposed that the facilitated sessions will offer an advanced knowledge surrounding the development process of children with the ability to apply these principles to allow social and communicative skill to progress for the individual children. When used together with the technology in this setting we also allow the child to develop social experiential knowledge in their interactions with technology by removing the solo user set up. All of this research is supported by primary research, yet at this stage, this presentation of knowledge is offered as a way to contextualise the research with the hope that it will begin to question the way in which technology is used within a school setting, and how Empathy, Mimicry and Touch are used as important tools when interacting with the autistic child, if they are being used at all.

References

- Astington, J.W. (1993). *The Child's Discovery of the Mind*. Cambridge, MA: Harvard University Press.
- Baron-Cohen, S. (2014). 'One on one...Simon Baron-Cohen'. *The Psychologist*. Vol. 27 No. 10, pp. 800.
- Davis, C. M. (1990). What is Empathy, and can Empathy Be Taught? *Physical Therapy*. Vol. 70, No. 11, pp. 32 - 36.
- Cullen, Barlow & Cushway (2005). Positive touch, the implications for parents and their children with autism: an exploratory study. *Complementary Therapies in Clinical Practice*. Vol. 11, pp. 182 - 189.
- Goldman, A. (1995). Empathy, Mind, and Morals. *Proceedings and Addresses of the American Philosophical Association*. Vol. 44, No. 3, pp. 17 - 41.
- Hewett, D. (2007). Do touch: physical contact and people who have severe, profound and multiple learning difficulties. *Support for Learning*. Vol. 22, No. 3, pp. 116 - 123.

Jackson, A (2014). Re-contextualising Empathy and Consciousness within the Study of Developmental Disorders In: M. Punt and M. Blassnigg (eds.) *Media Archaeology and Cognition – Transtechnology Reader 2014/15*, Plymouth: Transtechnology Research, pp. 208 - 245.

Keay-Bright, W. (2008). Tangible Technologies as Interactive Play Spaces for Children with Learning Difficulties: The Reactive Colours Project. *The International Journal of Technology, Knowledge and Society*. Vol. 4, pp. 1 - 19.

Keay-Bright, W. & Howarth, I. (2012). Is simplicity the key to engagement for children on the autism spectrum? *Pers Ubiquit Comput*. Vol. 16, pp. 129 - 141.

Lombardo, M., Barnes, J., Wheelwright, S. & Baron-Cohen, S. (2007). Self-Referential Cognition and Empathy in Autism. *PLoS One*. Vol. 2 e883.

Lord, S. (1997). Dance and Drama. In: Powell, S. & Jordan, R. *Autism and Learning*. London: David Fulton Publishers, pp. 79 – 99.

Thompson, E. (2001) Empathy and Consciousness. *Journal of Consciousness Studies*. Vol. 8 No. 5 - 7, pp. 1 - 32.

Torrents, C., Castaner, M., Dinusova, M. & Anguera, M. T. (2010) Discovering New Ways of Moving: Observational Analysis of Motor Creativity While Dancing contact Improvisation and the Influence of the Partner. *First Quarter*. Vol. 44, No. 1, pp. 53 - 69

Towards Modeling Song Propagation in Humpback Whales Using Multi-Agent Systems for Musical Composition

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Abstract

We present a multi-agent system which incorporates mobile agents that communicate using a simple song-grammar made up of a small vocabulary. Agents are attracted to move towards other agents who by singing demonstrate a similar grammar. Agents also adapt their grammars based on the singing of other nearby agents. The closer the nearby agents are, the greater the influence. These features consistent with a number of the proposed hypotheses for the singing behaviours of Humpback whales and other marine mammals. As a result of these features we show how over time the agents song grammars become more correlated, and agents which are closer geographically have more closely correlated grammars. Furthermore the agents group into clusters, or “schools”, which exhibit highly correlated grammars, and hence similar songs, and will tend to continue moving in these “schools”.

Keywords multi-agent systems, algorithmic composition, multi-agent modeling, humpback whale, artificial life, whale song

1. Multi-agent music

Multi-agent models have also been widely employed in fields such as evolution and ecology (Grimm and Railsback 2005). One of the first was “boids” (Reynolds 1987), which simulated animal flocking, herding and schooling. More recent have been multi-agent models of a lake aquatic eco-system (Lia et al. 2010), and earthworms (Blanchart et al. 2009). Multi-agent models are a useful tool for studying processes too complex to be satisfactorily captured by analytical approaches. Other examples of this approach include a model of cooperative foraging in bottle-nosed dolphins, which has been used to develop methods for coalition formation in multi-agent systems (Haque and Egerstedt 2009) and modeling whale watching tours (Anwar 2007).

Multi-agent modelling has been used in investigating the emergence of musical culture. In Miranda’s (Miranda et al. 2010) agents can selectively imitate each others’ performances depending on their musical preferences, giving a form of evolutionary algorithm that closely mimics the kind of social learning processes in animals, widely studied by Rendell (Rendell et al. 2011). As a result of the social bonding interactions a community repertoire begins to emerge. (Gong et al. 2005) produced a simple music composing system investigating the emergence of musical culture. It was found that in the emergent social network the agents tended to create clusters of preference factors according to their musical preferences.

These multi-agent musical culture techniques have been the inspiration for a number of computer-aided composition and performance systems. Kirke utilizes simple models in which agents sing to each other and concatenate their songs (Kirke and Miranda 2008). Kirke and Miranda follow a similar approach but when agents sing to each other, they change their musical range and pitch centre based on what they hear from other agents (Kirke and Miranda 2011). In (Kirke 2012) agents each have their own internal states representing motivation or emotion and adjust their songs based on this. Furthermore an agent adjusts its internal states based on the songs it hears and concatenates from other agents.

2. Cetacean communication

The vocal behaviour of cetaceans is a fast expanding current research area worldwide (e.g. (Yurk et al. 2002)(Noad et al. 2000)(Rendell and Whitehead 2003) to cite only 3 out of many). This interest is largely explained by the highly complex vocal behaviour of cetaceans, including vocal learning, vocal signatures and vocal dialects. This proposal focuses on the singing behaviour of Humpback whales. On winter breeding grounds male Humpback whales produce hierarchically structured songs with re-peated complex themes, cycling completely with a periods between 5-25min (Payne and McVay 1971). The precise function of the singing behaviour is a matter of ongoing debate. At any time, all males in a breeding population sing nearly the same song, but the song evolves structurally over time, changing noticeably over a breeding season, substantially over periods of several years, but remaining stable over the largely non-singing summer months (Payne and Payne 1985). Males sing virtually identical songs on breeding grounds thousands of kilometres apart, and the songs on these different grounds evolve as one. For instance, songs from Maui, Hawaii and Islas Revillagigedo, Mexico (4,500km apart) are similar at any time but change in the same way over a two-year period (Payne and Guinee 1983). For this to happen, there must be some level of interaction between singers in order for changes in song to be spread across populations. Scientists hypothesize that singing may aid grouping in populations (Darling et al., 2006).

The songs have been analyzed manually over the years but there has not been an automated extensive grammar analysis. An automated method was proposed in (Walker and Fisher 1997) but as far as we are aware was never investigated, and it was not based explicitly in developing multi-agent methodol-ogies. Like most language and western music, Humpback whale song has a hierarchical structure. The lowest level elements are basic units. These are organized into sets of units called phrases. A phrase usually consists of a unit pair, for example a pitch and a percussive sound, each repeated a number of times. The phrases are combined into sequences of one or more similar phrases, called themes. These themes can consist of one of several patterns of phrases. For example phrases that change very little,

or phrases whose content slowly moves from one type of unit to another. Groups of, usually, four to ten themes arranged in a relatively fixed ordering combine to make up the final song. Humpback whales repeat the song dominating their current population in song sessions lasting, often, for many hours. Some Humpback whale song units, which have been derived by (Walker et al. 1996)(Picot et al. 2008). Picot and collaborators determined 6 different patterns of Humpback song intonation through automatic segmentation of Humpback whale recordings. Walker and collaborators present further methods for segmenting whale song automatically, and comparing the units for classification (though they do not perform an exhaustive classification).

3. Multi-agent model of humpback whale culture

A multi-agent system is now introduced – inspired by the authors’ work in multi-agent music - which is proposed as a highly simplified model of humpback whale song and culture. Agents are located in a geographical two-dimensional space (a “sea”), and each agent has a song grammar, a song vocabulary, and the ability to move in the space (“swim”). All whales have the same vocabulary – these are abstract units (labelled “1”, “2”, “3”, etc.) which substitute for the individual sound units generated by fundamental whale biology. This abstract non-sonic nature is not considered an issue at this early stage in the model development. Others have worked on Humpback whale unit synthesis algorithms, and the integration of these will be examined at a later stage.

A whale’s location is represented by two numbers (x, y) . The song grammar is a transitional grammar. Transitional probability is a feature used to identify patterns by humans (Seidenberg 1997). A whale’s grammar is modelled as a simple 1-step Markov process. In this case each whale sound unit has a certain probability of being followed by another sound unit. So for example if the whale sings sound unit “1” then that whale’s grammar will denote the probability of each of the other sound unit’s occurring afterwards. The grammar is thus in the form of a 2-D Matrix. An example grammar is shown below for a whale with 5 vocabulary units.

0.04721	0.42405	0.11636	0.29206	0.12031
0.10727	0.16614	0.074008	0.2912	0.36138
0.16815	0.2302	0.19196	0.22466	0.18504
0.06909	0.30423	0.13002	0.29762	0.19905
0.10857	0.21881	0.18919	0.35496	0.12848

Row 1, Column 1 indicates the probability that after a whale has sung vocab-unit “1”, it will sing it again (probability 0.047219, very low). The largest number in row 1 is in column 2 (0.42405). This indicates that the most probable utterance for this whale, after it has sung a “1”, is to sing a “2”. Note that all the probabilities in a row add up to 1, indicating that at least one of the utterances must follow.

In this model, to generate a whale’s song, an initial unit is chosen (usually unit “1” in the experiments in this paper). Then a random song is generated of a fixed length, based on the probabilities in the whale’s grammar. So a whale will usually sing a slightly different song each time it sings, though it will always tend to sing in a certain way. The grammars can be designed to be much more tightly constrained than the above example. This corresponds to sparser matrices – leading to a whale singing only a small set of song variations.

4. Whale singing and influence

At each time step, when the model is running, a whale is randomly chosen from the population in the model. This whale will generate its song, as described above. This song will then be heard, with an intensity inversely proportional to the distance squared from the singing whale. So a whale 20 units away from the singer will hear the song with intensity factor 0.0025, whereas a whale 10 units away will hear the song with intensity factor 0.01. For larger distances in the real world whale song will obviously become inaudible. In this model the whale song is always audible if an agent is a finite distance from the singer, but become inaudible for all intents at purposes for large distances as it will have no influence on the distant whales.

The influence of the heard song is twofold:

1. Movement Influence
2. Grammar Influence

4.1 Movement influence

Whales all move by a small random amount at every time step. Furthermore, when a whale hears a song S it will move in the direction of that song, depending on how closely that song “fits in” with its own song (based on its grammar). So if a whale hears two whale songs equidistant to itself, it will tend to move towards the one which is most similar in structure to its own grammar. How does a whale compare a song to a grammar? This is done by generating what we call a “pseudo grammar” from the song. Suppose whale $W1$ hears the song S made up of the following units: “1”, then “3”, then “4” then “1” then “1”. In the model $W1$ infers a pseudo grammar whose maximum likely transitions are from 1 to 3 and from 3 to 4, 4 to 1 and 1 to 1. Below is an example pseudo grammar matrix that conforms to this:

0.4717	0.018868	0.4717	0.018868	0.018868
0.2	0.2	0.2	0.2	0.2
0.034483	0.034483	0.034483	0.86207	0.034483
0.86207	0.034483	0.034483	0.034483	0.034483
0.2	0.2	0.2	0.2	0.2

This pseudo grammar is then compared to its own grammar by taking the Cartesian distance between the two. The more likely it is that whale $W1$'s grammar could have produced song S , the more it will move towards the singing whale who sang S .

Obviously we are not suggesting that real humpback whales infer a grammar and perform a Cartesian distance (although European starlings can learn the statistical regularities within sound sequences constructed by an artificial grammar)(Berwick et al. 2011). However what we do know is that hump-back whale song is non-deterministic, so it is desirable to have

a statistical model rather than a fixed one. Furthermore, humpback whale song grammar is surprisingly complex and so it was desired to develop a sufficiently flexible model. This model allows for “almost-deterministic” sparse grammars to highly complex versions as well, and thus we feel it is a good first approximation to initiate further studies.

Movement influence is designed to cause whales which are likely to sing similarly structured songs will be close by.

4.2 Song influence

When a whale W_1 hears a song S , it adjusts its own grammar based on the song it has heard, and how loudly it hears the song. This is done once against using the pseudo-grammar approach. W_1 generates a pseudo grammar for S , and then takes a weighted average between its own grammar S . The weight is proportional to the cartesian distance from the singing whale. So if a whale is far away its song will have hardly any influence on W_1 , if it is close by its song will have quite a large influence on the grammar. If two whales have very similar grammars, they are more likely to sing similar songs (re-member all whales have the same vocab units in this model).

Song influence is designed to cause whales which are close to by to be more likely to sing similarly structured songs.

5. Example implementations

We will now look at an implementation in which whales move through 5000 cycles of singing. In each cycle a whale is randomly picked (uniform random) to sing (i.e. to generate a song based on its grammar). In that same cycle each other whale has its grammar influenced by the song of that singing whale (based on how loudly it hears the song), and moves towards the singing whale with a speed based on how similar their grammars/songs seem to be.

In this experiment we will have 6 whales, in a sea size of 200 units. Each

whale has a vocabulary of the same 5 utterance units: “1”, “2”, ..., “5”. When a whale’s grammar is influenced by the song it is hearing that influence is halved to 50% using a parameter *influenceFactor*. When a whale moves to-wards another whale based on that song it hears, its movement is divided by 100 using a *movementIn-fluenceFactor* of 1%. These parameter settings were found by experiment, though other values are viable. On top of the movement caused by moving towards other whales songs, a whale moves ran-domly in a random direction in steps of size $2 \times \text{movementInflu-enceFactor}$.

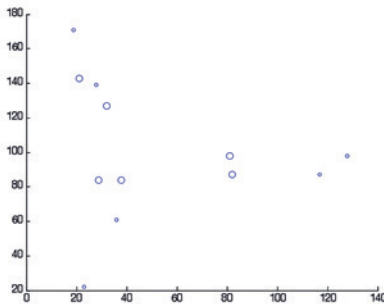
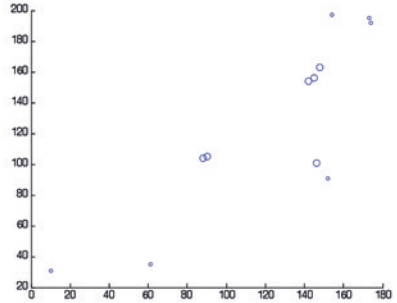
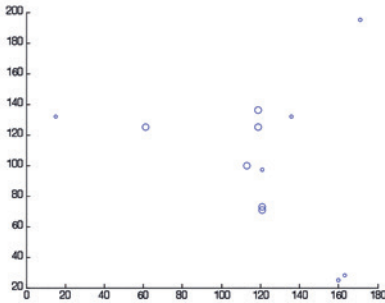
A series of 30 experiments were run. Across the 30 experiments the follow-ing was found:

- Whale grammars became more similar: the Cartesian distance between grammars shrunk by 54% on average
- Whales moved towards each other: The average distance between the 6 whales shrunk from 89 units to 42 units on average
- Whales that ended up closer together had more similar grammars: the correlation between whale closeness and the closeness of their grammars increased by 16% on average

Below are plots Figures 1, 2 and 3, from three separate experiments with the same parameter values as above. The small circles are the whales before the cycles are run, the large ones after 5000 cycles of interaction. They show how the whales are actually tending to cluster into subgroups or mini-“schools” in the “sea”.

Figures 4, 5, 6 and 7 were generated using the same parameter values but for 24 whales, and over 20000 cycles. They show 4 stages respectively in whale behaviour in the same experiment. Also the random direction move-ments (i.e. those not influenced by singing) are made 10 times as large so as to make whale movements more visible. The whale positions are plotted every 6000 cycles of interac-tion. Looking at the four figures it can be seen that whales in the <W1,W6,W15,W20> “pod” in the top left hand corner moves downward together. The whales in the <W5,W9,W17,W23> pod

in the bottom left corner move together. Similarly with the slower forming school in the bottom right hand corner: <W2,W10,W14,W19,W22>. Note because of the close distances kept over time, these whales in a pod will have much closer grammars. This closeness will lead to them moving towards each other, creating the geographical bonding cycle.



Figures 1, 2 & 3: Whale positions before and after 5000 cycles for three runs. Large circles are after the run

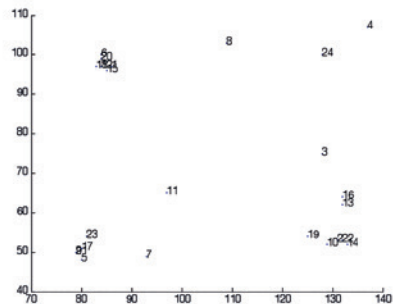
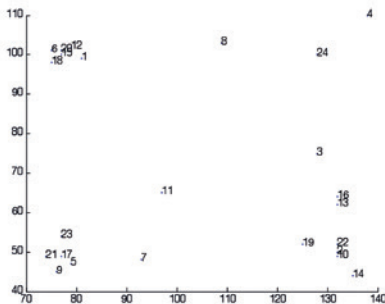
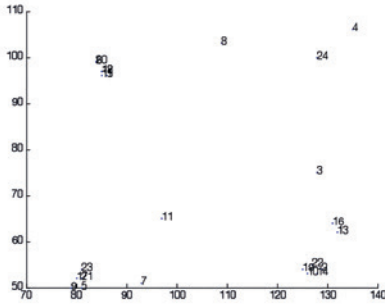


Figure 4: Whale schools moving together part 1

Figure 5: Whale schools moving together part 2



Figures 6: Whale schools moving together part 3

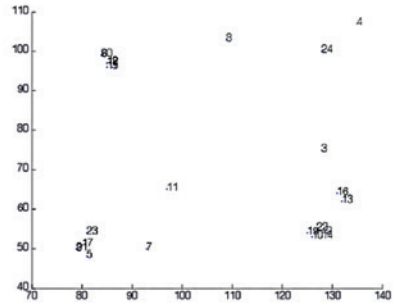


Figure 7: Whale schools moving together part 4

6. Conclusions and future work

In this paper it has been shown that a simplified model of humpback whale inspired by multi-agent music composition models, can be used to run experiments regarding simplified humpback interaction. As is found in real humpback whale pods, the model leads to the grammar of geographically close whales to being very similar. Furthermore it has been hypothesized by some biologists that whale song helps to bond whales in groups. The model demonstrates this hypothesis in action, where whales bond together into groups whose songs are similar, and then continue to move together.

In terms of future work the model needs to be extended to incorporate more features discussed in other hypotheses for humpback whale song purpose. Furthermore it needs to be extended to incorporate more elements known about humpback whale song. For example, real humpback whale songs are longer than the songs used in the current model, plus have more song unit types. Also modeling them as a first order markov model is unrealistic as true humpback whale song is shown to have a hierarchical musical structure which would require a higher order markov model.

References

Anwar, S. (2007) "Conceptualization and implementation of a multi-agent model to

simulate whale-watching tours in the St. Lawrence Estuary in Quebec, Canada”, *Environmental Modelling & Software* 22(12), Elsevier

Berwick, R., Okanoya, K., Beckers, G., Bolhuis, J. (2011) "Songs to syntax: the linguistics of bird-song" *Trends Cogn. Sci.* 16, 113–121.

Blanchart, E., Marilleau, N., Chotte, J.-L., Drogoul, A., Perrier, E. Cambier, Ch. (2009), "SWORM: an agent-based model to simulate the effect of earthworms on soil structure", *European Journal of Soil Science* 60(1), Wiley

Darling, J., Jones, M., Nicklin, C. (2006) "Humpback whale songs: Do they organize males during the breeding season?" *Behaviour* 143, 1051-1101.

Gong, T., Zhang, Q., Wu, H. (2005) "Music evolution in a complex system of interacting agents" *Proceedings of the 2005 IEEE Congress on Evolutionary Computation*, Scotland, UK

Grimm, V., Railsback, S. (2005) *Individual-based Modeling and Ecology*, Princeton University Press

Haque, M., Egerstedt, M. (2009) "Coalition formation in multi-agent systems based on bottlenose dolphin alliances", *Proceedings of the American Control Conference 2009*, St. Louis, USA

Kirke, A., Miranda, E. R. (2008) "An Instance Based Model for Generating Expressive Performance during Composition", *Proceedings of ICMC 2008*, ICMA

Kirke, A., Miranda, E. R. (2011) "A Biophysically Constrained Multi-Agent Systems Approach to Algorithmic Composition with Expressive Performance", *A-Life for Music: Music and Computer Models of Living Systems*, A-R Editions

Kirke, A. (2012) *Application of Intermediate Multi-Agent Systems to Integrated Algorithmic Composition and Expressive Performance of Music*, PhD Thesis, Plymouth University, Plymouth, UK

Lia, H., Mynetta, A., Penning, E., Qia, H. (2010) "Revealing spatial pattern dynamics in aquatic eco-system modelling with Multi-Agent Systems in Lake Veluwe", *Ecological Informatics* 5(2), Elsevier

Miranda, E. R., Kirke, A., Zhang, Q. (2010) "Artificial Evolution of Expressive Performance of Music: An Imitative Multi-Agent Systems Approach", *Computer Music Journal*, 34(1)

- Noad, M., Cato, D., Bryden, M., Jenner, M., Jenner, K. (2000) "Cultural revolution in whale songs", *Nature* 408:537, Nature Publishing
- Payne, R., Mcvay, S. (1971) "Songs of humpback whales", *Science* 173:587-597, AAAS
- Payne, R., Guinee, L. (1983) "Humpback whale, *Megaptera novaeangliae*, songs as an indicator of 'stocks'", in Payne, R., ed. *Communication and Behaviour of Whales*, Westview Press
- Payne, K., Payne, R. (1985) "Large-scale changes over 17 years in songs of humpback whales in Bermuda", *Zeitschrift fur Tierpsychologie* 68:89-114, Wiley
- Picot, G., Adam, O., Bergounioux, M., Glotin, H., Mayer, F.-X. (2008) "Automatic Prosodic Cluster-ing Of Humpback Whales Song", *Proceedings of 2008 International Workshop on New Trends in Environmental Sciences*
- Rendell, L., Whitehead, H. (2003) "Vocal clans in sperm whales (*Physeter macrocephalus*)", *Proceedings of the Royal Society of London B - Biological Sciences* 270:225-231, Royal Society Publishing
- Rendell, L., Boyd, R., Enquist, M., Feldman, M., Fogarty, L., Laland, K. (2011) "How copying affects the amount, evenness and persistence of cultural knowledge: insights from the social learning strate-gies tournament", *Philosophical Transactions of the Royal Society. B, Biological Sciences* , vol 366, pp. 1118-1128
- Reynolds, C. (1987) "Flocks, Herds and Schools: A Distributed Behavioral Model", *Proceedings of the SIGGRAPH 1987*, pp25-34, California, USA
- Seidenberg, M., (1997) "Language acquisition and use: Learning and applying probabilistic con-straints" *Science*, 275(5306), pp.1599-1603
- Walker, A., Fisher, R., Mitsakakis, N. (1996) "Singing Maps: Classification Of Whale-song Units Us-ing A Self-Organizing Feature Mapping Algorithm", *Research Paper No. 833*, Department of AI, University of Edinburgh, UK.
- Walker, A., Fisher, R., (1997) "Automatic Inference of Humpback Whale Song Grammar", *Project Proposal*, Department of AI, University of Edinburgh
- Yurk, H., Barrett-Lennard, L., Matkin, C. (2002) "Cultural transmission within maternal lineages: Vocal clans in resident killer whales in southern Alaska", *Animal Behaviour* 63:1103-1119, Elsevier

Get Ready for an Idea

A Brief Comparison of Existing Techniques to Support Cognitive Innovation

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Nowadays professional success and personal satisfaction can be greatly improved by innovations. To actually compare research results a number of tests have been developed over the past 65 years, which presumably measure traits that are believed to be connected to innovation and therefore creative problem solving and creativity. At the same time different conditions have been identified that supposedly foster or hinder creative thoughts. The interactive poster and this text invites you to try some of those tasks and compare your *creative performance* under selected conditions.

Keywords environment, creative problem solving, divergent thinking, convergent thinking, playful interaction, distraction

1 Introduction

Be playful! This is one of the recommendations that is repeated throughout the literature about creative problem solving and the administration of divergent thinking tasks. This acknowledges not only the *person* who is about to be involved in the creative *process*, but also the place – or more general the *press* as “the relationship between human beings and their environment” has been called in the original 4P framework by Rhodes (1961, p. 308). So whenever one of the P’s, including the previously not mentioned *product*, is going to be observed, measured, or described, the *press* should be taken into

consideration. While lab experiments try to control for some of the subsequently described modifiers, rarely all of them are supervised – even though they seem to have an influence on the results.

To stress the importance of those contributing factors, this poster *Get ready for an idea*, presented at the conference *Off the Lip 2015* invites the attendees to experience the impact of the *press* on their own performances. Some tasks are suggested which have been used to assess creative problem solving in the past. You, the reader of this text, are encouraged to do so as well and will have access to the online experiments at least until June 2017 (drop the author a note if something doesn't work as expected).

2 Modifiers

The following paragraphs contain a number of controls of the environment, the interaction between person and environment, and the participant itself. This list is by no means complete, but rather represent a few examples that address different groups of audiences in a number of different situations that might, to some extent, be applicable to participants in lab experiments. At least one research looking at the influence on creative problem solving tasks is cited for each condition. Again those citations are not complete, the intention was to provide just a few examples along with the opportunity to experience those effects first hand.

2.1 Sound and Ambient noise

Mehta, Zhu and Cheema (2012) claim that a moderate 70dB ambient noise increases creativity compared to a low 50dB level. A higher level of 85dB had a counter-effect by lowering the score achieved at a Remote Associate Tests (RAT). The noise used in this publication was either pre-recorded road-side noise, cafeteria, or construction noise played back at different levels. As a control condition participants were asked to complete the experiment in the normal laboratory settings with an average noise level of 42dB.

2.2 Mood

Research within different fields supports the idea that more positive affect increases creativity in problem solving. For example Bledow, Rosing and Frese (2013) measure the mood using a Positive Affect and Negative Affect Schedule (PANAS) inventory twice a day. In addition, in this study they asked the participants to self-report their real-life achievements during the workday. They show that an increase in the mood correlates with a higher creative self-rating during the day. Even though no clear causality can be extracted from the data itself, they argue that a better mood might foster higher achievements in creative problem solving.

On the other hand mood is also influenced by cognitive tasks according to Chermahini and Hommel (2012). Participants performing a divergent thinking task (Alternative Use Task, AUT) were in a better mood afterwards while participants in a Remote Associates Task (RAT) rated their mood less positively on the Mood Inventory (MI).

2.3 Intoxication

Jarosz, Colflesh and Wiley (2012) demonstrate that alcohol intoxication increases the number of solved Remote Associate Tests (RAT) and decreases the amount of time needed to do so. However, this might not be attributable to creative production, but rather to weaken mental barriers during the idea selection process. On the other hand, Plucker, McNeely and Morgan (2009) show that there is no correlation between the use of alcohol, tobacco, and marijuana and self-reported personality characteristics related to creativity assessed through the Adjective Check List (ACL).

2.4 Confidence and Self-Efficacy

Besides idea generation, a selection process is part of creative problem solving. Topolinski and Reber (2010) suggest that a higher confidence aids in trusting one's selection of the correct solution. They also see a connection to the mood, as positive affect seems to support creative problem solving. Encouraging participants could be based on findings in Weisberg and Alba

(1981): they demonstrated that participants can be trained for insight problems – they used the 9-dot problem as an example.

2.5 Meditation

In Ding *et al.* (2014), participants with no prior experience in relaxation or meditation methods showed a high increase in their performance of the Torrance Tests of Creative Thinking (TTCT) after an integrative body-mind training (IBMT). Participants who had prior experience with relaxation methods still improved their performance, but not as much as participants who had been trained in meditation.

In Colzato, Ozturk and Hommel (2012), two types of meditation – the focused-attention (FA) and open-monitoring (OM) – were used by participants to prepare for a Remote Associates Test (RAT) or an Alternative Use Task (AUT). The results show a better performance in the divergent thinking task for practitioners of the OM meditation, while the FA condition didn't have the predicted impact on the RAT performance. The better overall performance in both conditions can be partially attributed to the fact that practicing meditation changed the participants' mood, which then influenced their performance in both tasks.

2.6 Distraction

Baird *et al.* (2012) use an Unusual Uses Task (UUT) to assess divergent thinking. The comparison between different conditions suggests that being distracted from the main task by an undemanding and low effort task increases the score in the UUT. This finding is consistent with Dijksterhuis and Meurs (2006), who used an idea generation task (create pasta names ending with “i”) and reported a higher originality for participants in the distracted (unconscious thought) condition.

Participants can be distracted from their main task by low effort memorization tasks, e.g. by memorizing the names of all CogNovo fellows or solving anagram puzzles as suggested in Gilhooly, Georgiou and Devery (2013).

3 Participation

During the conference the attendees were asked to experience the influence of the *press* on their own creative problem skills. Each participant received a consent form with step-by-step procedures for each of the before mentioned condition and a number of tasks they could choose from. The tasks are short examples taken from previously conducted studies, just long enough for the participants to gain an understanding how their current condition they are in might influence their performance in that particular task. You, the reader of this text, are invited to experience the influence of those modifiers first hand as well. To get started choose a condition and follow the instructions given. If you are asked to choose a task, you can freely choose either one of your own divergent or convergent thinking tasks or you might want to select one of the provided ones. One more note: when you are asked for a *secret ID* – just give any kind of name or alias, if possible the same across all tests you choose to participate in.

3.1 Conditions

Intoxication

Precondition: Don't get yourself into this condition just for the task, but give it a go if you have just been to a pub or had a drink.

Procedure: 1) Choose any task; 2) Participate in as many rounds as you want; 3) Answer a few questions at <http://cognovo.eu/p16/pintox>

Ambient noise

Precondition: You are in a noisy place, for example a cafeteria, train station, or a play ground, but you are not involved in any direct interaction with others.

Procedure: 1) Choose any task; 2) Participate in as many rounds as you want; 3) Answer a few questions at <http://cognovo.eu/p16/pnoise>

Meditation

Precondition: You are trained in some kind of meditative practice and have just finished a routine.

Procedure: 1) Choose any task; 2) Participate in as many rounds as you want; 3) Answer a few questions at <http://cognovo.eu/p16/pmed>

Mood

Procedure: 1) Answer the questions at <http://cognovo.eu/p16/bmoo>; 2) Choose any task; 3) Participate in as many rounds as you want; 4) Answer the questions at <http://cognovo.eu/p16/pmoo>

Distraction

Procedure: 1) Choose any task and read the instructions; 2) Distract yourself, e.g. by a memorising names <http://cognovo.eu/p16/dist>; 3) Solve the task; 4) Answer the questions at <http://cognovo.eu/p16/pdis>

Self-Confidence

Procedure: 1) Read the text at <http://cognovo.eu/p16/bcon>; 2) Choose any task; 3) Participate in as many rounds as you want; 4) Answer the questions at <http://cognovo.eu/p16/pcon>

3.2 Tasks

Please choose any of the following tasks. All of them are simplified online versions and shortened in length. As their intention is to assist you in your self reflection on your creative problem solving skills, their administration is entirely in your hands. One more task was given to the attendees of the conference. Since it is still part of an ongoing research project it is not included in this document. Contact the author if you are interested in this particular task or keep an eye out for publications on the **Dira task**.

Remote Associates Task (RAT)

This task is a verbal, convergent thinking task introduced in Mednick (1962). Have a look at a simplified and shortened online version at <http://cognovo.eu/p16/rat>.

Instances Task

This is a verbal, divergent thinking task. It is mentioned in Wallach and Kogan (1965). Have a look at a short online version at <http://cognovo.eu/p16/instances>.

Alternative Use Task

This verbal, divergent thinking task was mentioned in Guilford (1967). Have a look at a similar type of task at <http://cognovo.eu/p16/aut>.

Pattern Meaning Task

Another task from Wallach and Kogan (1965) is an example for a visual divergent thinking task. Try it at <http://cognovo.eu/p16/pattern>.

4 Discussion and Conclusion

The poster *Get Ready for an Idea* draws together a number of findings in regards to the environment or *press* in which problems are solved. While this document is not much more than a reminder of and a hint towards those existing studies, it also invites attendees of the conference and readers of this text to experience those conditions first hand. The intention is to draw attention to those often forgotten modifiers only very few experimental settings control for in their entirety. Feedback and discussions during the conference supported the call for taking environmental and personal conditions more vigorously into account for future research. This should go far beyond the administrative request to the participant to solve the problems playful or providing a playful setting, rather observing, measuring and, most importantly, **understanding** what has been termed **playfulness** should be the responsibility of us researchers.

References

- Baird, B., Smallwood, J., Mrazek, M. D., Kam, J. W. Y., Franklin, M. S. and Schooler, J. W. (2012) 'Inspired by distraction: Mind wandering facilitates creative incubation', *Psychological Science*, 23, pp. 1117–1122. doi: 10.1177/0956797612446024.
- Bledow, R., Rosing, K. and Frese, M. (2013) 'A dynamic perspective on affect and creativity', *Academy of Management Journal*, 56, pp. 432–450. doi: 10.5465/amj.2010.0894.
- Chermahini, S. A. and Hommel, B. (2012) 'Creative mood swings: Divergent and convergent thinking affect mood in opposite ways', *Psychological Research*, 76, pp. 634–640. doi: 10.1007/s00426-011-0358-z.
- Colzato, L. S., Ozturk, A. and Hommel, B. (2012) 'Meditate to create: The impact of focused-attention and open-monitoring training on convergent and divergent thinking', *Frontiers in Psychology*, 3. doi: 10.3389/fpsyg.2012.00116.

Dijksterhuis, A. and Meurs, T. (2006) 'Where creativity resides: The generative power of unconscious thought', *Consciousness and Cognition*, 15, pp. 135–146. doi: 10.1016/j.concog.2005.04.007.

Ding, X., Tang, Y.-Y., Tang, R. and Posner, M. I. (2014) 'Improving creativity performance by short-term meditation', *Behavioral and Brain Functions*, 10. doi: <http://dx.doi.org/10.1186/1744-9081-10-9>.

Gilhooly, K. J., Georgiou, G. and Devery, U. (2013) 'Incubation and creativity: Do something different', *Thinking & Reasoning*, 19(2), pp. 137–149. doi: 10.1080/13546783.2012.749812.

Guilford, J. P. (1967) *The nature of human intelligence*. McGraw-Hill, p. 538.

Jarosz, A. F., Colflesh, G. J. and Wiley, J. (2012) 'Uncorking the muse: Alcohol intoxication facilitates creative problem solving', *Consciousness and Cognition*, 21, pp. 487–493. doi: [doi:10.1016/j.concog.2012.01.002](https://doi.org/10.1016/j.concog.2012.01.002).

Mednick, S. A. (1962) 'The associative basis of the creative process', *Psychological Review*, 69(3), pp. 220–232.

Mehta, R., Zhu, R. J. and Cheema, A. (2012) 'Is noise always bad? Exploring the effects of ambient noise on creative cognition', *Journal of Consumer Research*, 39(4), pp. 784–799. doi: 10.1086/665048.

Plucker, J. A., McNeely, A. and Morgan, C. (2009) 'Controlled substance-related beliefs and use: Relationships to undergraduates' creative personality traits', *Journal of Creative Behavior*, 43(2), pp. 94–101. doi: 10.1002/j.2162-6057.2009.tb01308.x.

Rhodes, J. M. (1961) 'An analysis of creativity', *The Phi Delta Kappan*, 42(7), pp. 305–310. Available at: <http://www.jstor.org/stable/20342603>.

Topolinski, S. and Reber, R. (2010) 'Gaining insight into the “aha” experience', *Current Directions in Psychological Science*, 19(6), pp. 402–405. doi: 10.1177/0963721410388803.

Wallach, M. A. and Kogan, N. (1965) *Modes of thinking in young children. a study of the creativity-intelligence distinction*. Holt, Rinehart,; Winston, Inc., p. 357.

Weisberg, R. W. and Alba, J. W. (1981) 'An examination of the alleged role of “fixation” in the solution of several “insight” problems', *Journal of Experimental Psychology*, 110(2), pp. 169–192.

Catastrophe, Sense of Crisis, Cultural Responses: Exploration into the Location of Violence in the Post-3.11 Japan

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Abstract

This paper, at most manifest level, examines the selective cultural responses toward the recent major earthquake and Fukushima nuclear disaster in Japan. Since March 11, 2011, Japan has suffered from the earthquake and its aftermath. Most physical damage was caused by the tsunami and although so many houses, schools, businesses and other constructions were shattered by its brutal wave, the severest impact was brought by the meltdown at the Fukushima Daiichi Nuclear Power Plant. This unprecedented and ongoing accident invoked a set of urgent yet lasting problems that otherwise would not have been fully addressed. There has been a lot of strong emotion among people; frustration, anger, a sense of hopelessness, of betrayal and of mistrust toward the politics, the involved corporations, and the information disclosure, to name only a few. But most of all, there has been a strong sense of lasting crisis, some manifest while others more subtle.

It is, then, this paper's second task, somewhat theoretical one, to examine the relationship between this sense of crisis and some of the cultural responses that are produced under it and explore the location of violence suggested by such responses. Crisis, of course, if we follow Walter Benjamin, is a moment at which one's epistemic framework ceases to sustain his "ordinary" everyday life. His understanding is challenged, belief system questioned, and cognitive limit shaken and pushed. It could be an opportunity to sense the ruptures within the current totalizing, normalizing system and

reimagine an alternative future. Yet, crisis is also a moment at which one stubbornly seeks to recover his once familiar system, restore his shattered belief, and hold on to the precedent remedies.

The paper focuses on selective cultural responses toward the serious catastrophe. In that, it is a preliminary, speculative approach toward the relationship between crisis and expression, and catastrophe and creativity.

Keywords location of violence, social pain and suffering, cultural responses, crisis, post-3.11 japan, attempt of anti-violence

The event

As many of us already know, Japan has been suffering from the aftermath of the major earthquake that happened on March 11th, 2011. It devastated the coastal area of North-Eastern part of Japan. Because the earthquake happened on March 11th, many Japanese refer to this event as “3.11 (*san-ichi-ichi or san-ten-ichi-ichi*),” as in the case of “9.11,” which, of course, indicates the multiple attacks that took place in the U.S., 2001.

The devastation in the region was caused not so much by the earthquake itself, but rather by the tsunami that basically wiped out or destroyed the coastal area, including the Fukushima Daiichi Nuclear Power Plant. The tsunami wave was claimed to be “unexpectedly” high and went above the wall built around the plant, causing the power system to fail and thus the cooling system to shut off. A lot of media in Europe and America used the biblical term “Apocalypse” to describe the event. Indeed, the first few months observed not so much a chaotic panic but a subdued apprehension and a foreboding image of inevitable extinction of human species.

But there is nothing religious or sacred or mythical about the nuclear disaster. It was later admitted even in the official report by the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC) that it was a “manmade disaster (人災 *jinsai*)” not a “natural disaster (自然災害 *sizen-saigai*),” which means that this nuclear disaster “could and should have been foreseen and prevented” (NAIIC 2012). Some of the safety measures which should have been taken were disregarded, so the report claims.

This was not, or should not have been I should say, a surprise, for there had been several nuclear accidents in Japan prior to 3.11. What was surprising and mythical was the degree to which some of the safety myths had penetrated the population. That many journalists and academics suddenly talk about the collapse of the safety myth in Japan bespeaks of how strong they believe in the myth. And here, I have to admit that I was no exception. Regardless of how critical I thought myself to be, I was also somehow induced to believe in this myth. That is to say, I was a part of this belief system. In that, when the earthquake hit, I was there in Tokyo not only as an “observer” trained in the field of cultural anthropology, but also as a “witness,” as James Baldwin would put it, one who happens to be there and experience it with partial and limited perception when a critical event takes place. I was in fact one of many witnesses. In this paper, I would, to be fair, give up on following a conventional method of describing and interpreting only as a critical observer and try to combine the position of witness as well.

Question of violence and theoretical framework

Before going any further, however, allow me to state a little bit of what I intend to do in this paper and elaborate on my theoretical framework. Rather than getting too much into detail on what has been happening in post-3.11 Japan, I would like to explore the location of violence throughout this whole event and describe some of the cultural responses toward it. This exploration into the location of violence, and of social pain and suffering, and of cultural responses to cope with such pain and suffering has been my main theme for over ten years now. It first came clear to me as I was conducting my fieldwork in the African-American Muslim communities in Harlem, New York.

When I started my fieldwork in the fall of 2002, approximately one year after 9.11, there was a lot of frustration among African-American Muslims, not only about the white population and American society, which (stereo-)typically represented their oppressing counter-part, but also about African-American Muslims themselves and Harlem community in which they lived. Their frustration, concern, and anger were in a way sustained by their perpetual sense of crisis cultivated in their historical and socio-cultural

contexts and passed on through their cultural expression. Their sense was based on the constructed and reconstructed historical reality in which their past, family, language, and culture were completely destroyed at one point through the institution of slavery and severely damaged through various forms of racism. And their voice – from outcry to stammer to grieving sounds – seemed to hint at the existence of violence embedded and somewhat covered in the larger socio-cultural time and space. Thus, I began my search for the location of violence in their everyday. I say “hint at,” because their strong and sometimes (counter-)racialist remarks were influenced by the narratives of the Nation of Islam and should not be taken literally, though many of the Muslims I interviewed were not affiliated with the Nation any more (Nakamura 2015).

The specific form of violence I was observing at that time was somewhat symbolic and structural one, as Pierre Bourdieu would put it (Bourdieu and Wacquant 1992). Such violence is all subtle and largely goes unnoticed. Yet when people try to expose it through complaint and protest especially in the manner of street culture, their voice tends to be considered “violent” by many in the mainstream culture, not only because it challenges the status quo and “violates” the existing structure, habits, and laws, but also does so in an unfamiliarly challenging manner. And indeed, their strong, emotional language, their bodily street expression, their ways of laughing, of making jokes, of strutting, of greeting, of affirming and negating might seem “violent” to the outsiders of the community.

To be sure, I am not suggesting every street expression can and should be justified, but I am suggesting the unequal relationship between the mainstream institutional culture and street culture. Moreover, I argue that this disproportionate composition parallels the relationship between Gewalt (structural forces) and violence, shown by Walter Benjamin (1996). This poses an epistemological question of violence and further entails the cognitive aspects of how we conceive of violence. What is clear here is that violence is unevenly distributed. Violence implemented in the state, institution, system and mainstream larger culture is unmarked and usually goes unnoticed. On the other hand, violent expression and confrontation in the already marginalized street culture are clearly marked and easier to point out.

Thus, whenever a story about gang violence in an inner-city is reported, it is easier to picture a horrendous nature of slum and ghetto. Whenever people hear a rapper employ the vulgar expressions, it is easier for them to problematize the “uncivilized” manner and conclude that hip-hop somehow promotes violence. But violence of putting people into prison, violence of educating people in such a way as to assimilate them into a certain culture, and violence of setting a standard and defining what is vulgar and violent, largely go undetected.

This contrast between Gewalt and violence, the structural force and its violation, is, of course, already pointed out by many including Friedrich Nietzsche, Walter Benjamin, Michel Foucault, and recently by anthropologists such as Talal Asad (2003, 2007) and Gyanendra Pandey (2006). Following Pandey, for example, a list can be made on such an unequal power structure: war vs. terrorism, diplomatic policy vs. street demonstration/protest, corporation vs. religious group, boxing vs. dogfight, classical music vs. rap, killing and eating of oxen vs. of whales or dolphins or dogs.

Again, I am not suggesting that the latter in the list are less violent and justifiable, but am simply saying along with Asad and Pandey that the effect of the violence of the former tends to be larger and more massive than that of the latter. Yet, on very limited occasions you find them being recognized and criticized as violence. And more importantly, there is a strong tendency to point out the violent factors in people or society or culture other than the critics' own.

Social situation and selective cultural responses in Japan

How is this relevant to what has been happening in post-3.11 Japan? Let me go back to the original topic and describe the situation in Japan.

We have seen Three Mile Island (level 5). We have seen Chernobyl (level 7). But Fukushima (level 7) is unprecedented in the sense that it is still ongoing almost five years after the accident and will go on for many years in the future. Among many thinkers and activists in Japan, a sociologist Michinobu Niihara (2012, 2013) has coined the term “unfathomed future (見知らぬ明日 *mishiranu-asu*)” to emphasize the criticality of the present, at which the futurity of the mankind is ever more gravely dependent on our judgment

and choice regarding how we live our daily lives.

My use of the term “we” here in this case and in relation to any of the nuclear related incidents gives me a strange feeling in that it indicates “we” as a human being including myself on this planet because the effect of radiation easily exceeds the boundaries of one region or nation, but at the same time it also suggests a small number of people not including myself, who actually pursue this difficult and extremely risky task of shutting down the plant. To name a few, we still have to take out the nuclear fuel rods and keep cooling them. We still have to find a way to manage the contaminated water that keeps draining. We still have to somehow deal with contaminated soil that keeps piling up.

This is an unprecedented, long-term crisis. Thus, in Japan people are experiencing, along with the political mess and the correlated distrust and frustration, and economic and other crisis and the intertwined anxiety, this massive, life-threatening crisis that could interfere with the whole biosphere. For about the first six months after 3.11, I remember vividly that the responses of people in Tokyo area including myself were that of anger, frustration, sense of powerlessness, and sense of crisis. Tokyo is about 220km away from Fukushima Daiichi Nuclear Power Plant, but it does not in any way imply that the area was not affected.

These first six months were also the time of self-reflection. There was a strong sense among many that there was something fundamentally wrong about the system we live in and the kind of life we lead. Many people did not know that there were fifty-four nuclear power reactors on this small island that was so prone to earthquake. Many in Japan did not know that building of those nuclear power plants had been backed by the post-war government’s policy that tried to promote so-called “peaceful use” of nuclear power, which is also tied to American policy that is in turn linked to the world system under the Cold War regime. Ever since 1945, after the actual use on civilian in Hiroshima and Nagasaki, there has been over two thousands nuclear test explosions, one thousand fifty-four conducted by the U.S, seven hundred fifteen by Soviet Union, forty-five by UK. It is hard to point out one single country or government for being responsible.

I remember reading students’ final papers for the Cultural Anthropology course a few months after the earthquake. This is the course I teach every

year at Tama Art University and at the end of semester I ask every students to write an essay about what they learned and how it was related to their experience. This is an art university so all of my students are basically either young artists or designers. What was remarkable that year was that many of their writings include some kind of deep self-reflection. I did not ask them to do so. Nor did I change the topics of the lectures that year. Nevertheless, many of them touched upon their deep emotion, and their traumatic events. It does not mean that they directly talk about the earthquake but they talk about their personal experience.

It was as though they were living a moment of crisis in Walter Benjamin's sense. It was a moment, in which violence of the existing system, of the ordinary life reveals itself through a wounded crack of seemingly continuous time and space. It was a moment, in which people reflect upon the whole structure, conceive of something different, and seek for alternatives. But after about two years, there has been a strong backlash as well. Call for "revival (復興 fukkou)" has been prevalent. There has been a strong move to cover up not only the wound itself but also the systemic violence that created the mess in the first place. To mention a few among such backlash, Japan has so far decided to rerun two of the nuclear power plants, one in Fukui (*ooi Nuclear Power Plant*) and the other in Kagoshima area (*sendai Nuclear Power Plant*), in the midst of a big protest.

Location of violence

Where does violence lie in this? And what does this situation in Japan tell us about the economy of violence? Violence is, of course, everywhere. It always has been, and always will be, everywhere – within even the most peaceful places and the calmest moments, within the most generous gifts, within tedious yet innocent everyday life. But to even say that to include virtually everything in sight under the category "violence" is also violence, or could become one, by disregarding its specificity, but to talk about a specific violence perhaps necessarily involves exclusion of other (possible) forms of violence. And then, there is suffering, and pain, and anger, already from the very beginning, even before the day we realized that we were born on this planet.

But the most serious violence, I submit, is almost unobservable. What is observable under the influence of this kind of violence is pain and suffering, damage and devastation, people's outcry and scream. I can already see my colleagues yelling at me, "But what about pornography of violence? Don't people taboo violence and want to look at it at the same time? Didn't 20th century observe series of visualized violence on film screens, TVs, and later on the Internet?" But I would say that what we see is exhibition, if not pornography, of pain and suffering, not of violence. Violence itself is somewhere behind such representation.

The most devastating kind of violence is often unseen because it is embedded in a conception that is usually not considered violent. The conception of nuclear energy, for example, is generally considered scientific and neutral. Many would claim that it is not the technology itself that could do harm, but the people's bad use of it that may lead us to catastrophe. We should note here that the separation of what (the content) from how (the usage) constitutes an integral part in modern scientific thinking that emphasizes the data over the meanings and is an arbitrary construction under a particular time and space.

There are many elements of creativity and imagination involved in the actual making of nuclear power plant. And creativity and imagination, again, are the terms that are almost always used in a positive way. Not many people talk about the violence of creativity and imagination.

My take on violence here somewhat resembles the concept of the Firstness submitted by Charles Sander Peirce and is influenced by his famous maxim of pragmatism or later called pragmaticism. He writes, "Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object" (Peirce, 1931[*CP*, 5.2.]).

It clearly shows that Peirce was interested in the effect that a conception would have. In Peirce's formulation, Firstness is "quality of feeling" that is "mere may-be[s], not necessarily realized" (Peirce 1931[*CP* 1.304.]). While Peirce uses many terms to explicate what he conceives of his phenomenological categories, his Firstness is characterized by something that is not yet realized nor actualized. It is, for him, something that is probable and possible. He writes, "That mere quality, or suchness is not in itself an occurrence,

as seeing a red object is” (Peirce 1931[*CP* 1.304.]). Seeing a red object is an actual experience, an event in which one physically encounters outside of one’s mind an object that confronts him. However, one *is able to or would* conceive in his mind a red object without actually seeing the material, and *that* probable conception is Peirce’s Firstness. It is a feeling that is not yet materialized. In Peirce’s own words, “Its only being consists in the fact that there might be such a peculiar, positive, suchness in a phaneron” (Peirce 1931[*CP* 1.304.] Emphasis omitted). It is a “steadily continuing possibility,” which is not yet in existence but “not nothing” at the same time (Peirce 1998: 269).

I attribute the kind of violence we have seen in this paper to Peirce’s Firstness because it is a phenomenon that is not necessarily materialized nor visualized. I use the term violence to include an element that exists as a mere possibility. The effect of such violence is either hidden or not visualized. Thus, it is difficult to observe. It is very hard to locate precisely because such violence is embedded in the current system, institution, structure, or law that continuously, as if in the case of homeostasis, attempts to reaffirm itself. In some cases, there might be cognition of pain and suffering prior to recognition of violence. In other cases, one might accuse himself or stigmatize himself. Or unable to specify the cause or reason, one’s body might scream, feel fatigue or weariness, experience stroke or seizure, and exhibit some kind of physiological symptom.

It is only when an element of force that has always already been there comes in contact with a kind of law – habits, codes, patterns, rules, etc. – that it comes to be perceived as being a “violation” (Bejamin 1996; Sakai 2004). But such violence is recognized, defined, and judged only in relation to “force of law” (Derrida 1994). Therefore, this “force of law” at once reveals an element of violation and covers its own Gewalt (violence). An element of force on the side of law – from something that is legalized to something habitualized – is harder to acknowledge as violence. Such an element is not yet in existence prior to being perceived as that which violates the existing laws and habits and rules (whether they are implicit or explicit), but its existence and its possible effect can be and could have been conceived in the realm of possibilities, probabilities, and potentiality. That is, it can be understood as Peirce’s phenomenological Firstness.

Conclusion: cultural attempt of anti-violence

It has been almost five years since 3.11. I am not sure how this relates to any of the students' paper I read back in 2011, but I have observed so far a stronger effort especially by the young generation in Japan to search for alternative ways of life. This is not to say such an effort is new or unprecedented. Nor do I intend to over-romanticize their attempt. But it has gotten stronger, more explicit and ever more prevalent than before. In short, increasing number of people are choosing to take a path that was not considered "right" or "legitimate" ten or twenty years ago. To name a few examples, some have moved to rural areas and started building their own farms. Others have formed their own companies to try an alternative business model. There is a stronger sense of autonomy and self-reliance, and of inter-dependency and of ties.

Shinichi Tsuji (aka Keibo Oiwa), a cultural anthropologist and environmentalist, was quick to point out this change. The author of the influential book *Slow is Beautiful: Culture as Slowness* (2001), which was inspired by Ernst F. Schumacher's *Small is Beautiful: A Study of Economics as if People Mattered* (1973), and one of the leading organizers of the "slow movement," Tsuji employs the term "cultural creatives" (the title of the book by Paul Ray and Sherry Anderson) to describe the changing ways of life among those people in Japan. What is noteworthy is that such a move is being made without radicalizing themselves. In other words, it does not really take the form of segmented protest or hysteric demonstration, as it did in the case of students' movement during the 1960s and 70s. Nor do they exhibit a sign of strong frustration. It is mostly done softly and quietly. Even Students Emergency Action for Liberal Democracys (SEALDs), one of the most prominent politically engaged students' group, is taking action without forming any sects. It makes a sharp contrast both with the previous students' movement in Japan and the street culture.

I would like to call this movement an alternative attempt of "anti-violence." It is a different way of countering a systemic violence of everyday. What kind of effect this movement is going to produce in the long-run is still hard to determine, but it seems to be creating a culture of coping with the structural violence in Japan.

References

- Asad, T 2003, *Formations of the Secular: Christianity, Islam, Modernity*, Stanford University Press, Stanford.
- 2007, *On Suicide Bombing*, Columbia University Press, New York.
- Benjamin, W (translated by E Jephcott) 1996, "Critique of Violence," in *Selected Writings vol. 1*, Belknap Press, Cambridge, Massachusetts, pp. 236-252.
- Bourdieu P and Wacquant L 1992, "Symbolic Violence" in *An Invitation to Reflective Sociology*, University of Chicago Press, Chicago, pp.140-174.
- Derrida, J (translated by M Quaintance) 1992, "Force of Law: The 'Mystical Foundation of Authority'" in David Gray Carlson, Drucilla Cornell, and Michel Rosenfeld eds., *Deconstruction and the Possibility of Justice*, Routledge: New York.
- Nakamura Y 2015, *Zankyou-no Harlem: Street ni ikiru muslim-tachi-no koe [Howling Harlem: Voices of Muslims on the Street]*, Editorial Republica, Tokyo.
- The National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission 2012, *Executive Summary*. (<http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naic.go.jp/en/report/>)
- Niihara, M 2012, "Il disastro nucleare di FUKUSHIMA. Scelte energetiche, società civile, qualità della vita", nel *Quarto seminario FOIST su Esperienze internazionali nell'università*, Università degli Studi di Sassari.
- 2013, "Exploratory Social Research on the Multiple Problems in the Planetary Society: Toward Reconstructing 'Regions and Communities for Sustainable Ways of Being' after 3.11," *Journal of the Faculty of Letters Sociology/ Socio Informatics*, The Faculty of Letters Chuo University [23], pp.47-75.
- Pandey, G 2006, *Routine Violence: Nations, Fragments, Histories*, Stanford University Press, Stanford.
- Peirce, CS 1931, *Collected Papers of Charles Sanders Peirce*, Harvard University Press, Cambridge, Massachusetts.
- 1998, *The Essential Peirce: Selected Philosophical Writings*, Vol. 2, University of Indiana Press, Bloomington.
- Sakai, T 2004, *Bouryoku no Tetsugaku [Philosophy of Violence]*, Kawadeshobou Shinsha, Tokyo.

Quantum Creativity: Robert Creeley and Projective Verse

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Abstract

How can we represent reality if reality is not only *without* but *within*, that is, if reality is 'all that is', a totality that includes things, thoughts, and words? Robert Creeley (1926-2005) attempts to answer the question by placing the poet himself within rather than outside the reality that he purports to describe, so that when he speaks about it, he is speaking from within the picture that basically contains himself. His poetry embodies the paradox of self-referentiality in quantum physics, attempting to describe the objective reality only by being itself inherent part of it. Creeley firmly locates his poetry in the bodily act of language. He participates himself, in the process of creation, as another object which has its own biological rhythm. Much of David Bohm's interpretation of quantum field theory and the theory of embodied cognition take place at this level, a level at which mind and matter are indivisible. It is not the brain alone that is thinking, that is stringing along words, but the entire body of the poet through subtle muscular movement which unfolds or emerges into thoughts and meaning. In Creeley's poetry neither thinking nor feeling are recognized as such until their associative patterns are materialized into words and syntactic structures. I will demonstrate that creative thinking may be experienced as a quantum-like thought process, or *quantum creativity*, in which reality from within is indistinguishable from reality from without.

Keywords Robert Creeley, projective verse, quantum creativity, quantum field theory, embodied cognition, rheomode

Introduction

Quantum field theory describes that subatomic particles are but manifestations of the underlying field and more importantly that the quantum observation depends on human interaction at the very fundamental level. In quantum physics, the observer is inextricably bound up with the physical universe he observes. In this sense, quantum field theory shares a common ground with the recent theories of embodied cognition, together providing a fitting introduction to Creeley's poetry, in which one can find a striking world of parallelism between subject and object, mind and body, language and reality. The work of Creeley's poetry can be considered as an attempt to construct aesthetic counterparts that would answer to the challenges posed by the groundbreaking scientific thoughts. Creeley's poetry tends to place the poet himself within rather than outside the frame of reality, so that when he speaks about it, he is part of the reality that he purports to describe. The aim of this research project is to explore the relationships between the philosophical underpinnings of quantum physics and embodied cognition, and the poems and poetics of Robert Creeley, particularly written in the sixties and seventies, that are deemed to embody the principles of Projective Verse.

Creeley & Projective Verse

Robert Creeley is associated with the Black Mountain Group in the 50s and 60s led by Charles Olson (1950), whose famous "Projective Verse" manifesto detailed a theory of poetry that included 'the world' with which a poet interacts with his body. Olson's such 'embodied' view of poetry is also similar in character and role to the concept of field in quantum physics. For Olson, projective poems would employ words to create a field of energy on the page, and he posited that this linguistic field ought to correspond to the "kinetic" (1950: 16) energy in reality. However, Olson and Creeley developed their theories and modes of composition by exchanging letters for

more than two decades. Fredman (1990: 62) notes, "The two writers were ... intimately involved in the emergence of each other's characteristic styles, theoretical positions, and even diction". Although Creeley was not a theorist or a cultural critic like Olson, he is the most original and faithful practitioner of the Projective Verse. "Creeley found in Olson ... a critical intelligence to match his creative achievement" (Fass 1978: 148). Moreover, Creeley's field of action, as I will discuss, is focused on the moment of great emotional intensity with unbroken attention to the language at work, which comes to unite matter and consciousness, mind and body, in a seamless way.

Quantum Field & Embodied Mind

In quantum physics, there is no such thing as objective observation. The observer is inextricably bound up with the physical universe he observes. Heisenberg (1955: 29) emphasizes that "Science no longer confronts nature as an objective observer, but sees itself as an actor in this interplay between man and nature". Put another way, in quantum physics, human beings become observer-participants in the universe around them. Scientists observing reality in quantum experiments is not different from nature interacting with nature, which is but the fundamental interactive quantum reality. Such scientific ideas may find their aesthetic counterpart in Creeley's poetry, in which the poet does not seek to describe but enact or participate with his body. Language is a dance then improvised, not to a human measure, but to a natural measure, to the breath, the heartbeat. To be at one with the body means to be at one with nature, with the rest of its creatures. The act of writing then makes the poet realize the full force of words as they are continuously incorporated into the breathing rhythm of the body. For Creeley, subject and world have their origin in mutual encounter; they shape each other. Reality is continuous, not separable, and cannot be objectively 'described' but only 'enacted' by the poet. The so called "mind" and "body", in this sense, can be understood as shaped by mutual participation or interaction that constitutes what we call experience. According to Johnson and Lakoff (2002: 248), "experience is the result of embodied sensorimotor and cognitive structures that generate meaning in and through our ongoing interactions with our changing environments". On this view,

cognition is not some inner process performed by "mind," but rather is a form of embodied action. So, there is no need for inner ideas that could somehow capture what is out there in the world. "We are, instead, *in and of* the world" (Johnson 2007: 145).

Creeley's poetics echoes the quantum field theory, according to which the entire universe should be regarded as a single indivisible field in which separate parts appear as manifestation or excitation observable only on a classical level of accuracy of description. What we used to call subatomic particles are not exactly particles, or "things", at all. So, it is the quantum field from which the particles emerge as its quanta, as pattern of energy or excited states of the underlying field. The subatomic particles "only appear to be substantial as a result of the dynamic, energetic interplay of the quantum fields" (Panda 1991: 155). They are integral parts of an inseparable network of interactions. The interactions between actual particles are particularly mediated by or calculated in terms of exchanges of virtual particles. The virtual particles are not observable nor detectable, but nevertheless real. They pop in and out of existence all the time. In quantum field theory, all particle interactions can be pictured in Richard Feynman's diagrams (Figure 1).

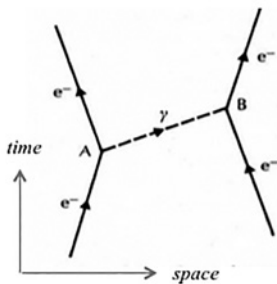
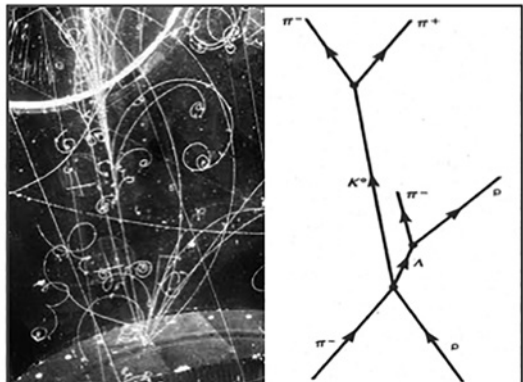


Figure 1. Richard Feynman's space-time diagrams (1949)



All particles can be transmuted into other particles; they can be created from energy and can vanish into energy. Subatomic particles forever partake of "this unceasing dance of annihilation and creation" (Capra 2010: 240), the ceaseless flow of energy manifesting itself as the exchange of particles. Creeley's poems can be characterized by broken syntaxes and discrete images with an instantaneous formation of an association or an unexpected leap of comparison. Fragmentation is indeed a clue to the mysterious whole in Creeley's poetry. The disjointed and disjunctive rhythms of Creeley's poetry exhibit the transference of energy from one point to another in the quantum field, making us see the behavior of language--syllables, words, phrases--as packets of "quanta" that leap. In quantum physics, energy is emitted and absorbed not continuously, but in small packages called "quanta". Max Planck's constant (h), which physicists call 'quantum of action,' represents the quantized nature of energy emission and absorption. Creeley's discrete poetic energy with short wave (line) lengths indeed allows for abrupt changes in direction and thus keeps the eye of the reader continually in motion, creating the impression of a flow of discontinuous sensations as we can see in "Walking" (Creeley 1982: 282).

In my head I am
walking but I am not
in my head, where

is there to walk,
not thought of, is
the road itself more

than seen, I think
it might be, feel
as my feet do, and

continue, and
at last reach, slowly,
one end of my intention.

All of the occasions or events here are handled as a series of objects in a field, and they must be made to hold sequences of tensions inside the 'content and context' of the poem. They are but manifestation of the underlying field of rhythm, as in quantum physics, "particles are expressions of the field's conformation at a given instant, appearing as the field becomes concentrated at one point and disappearing as it thins out at another" (Hayles 1984: 16). This view of relationship between particle and field is remarkably similar to Creeley's idea of 'mind' that is already embodied. There is no separation between mind and body. Our rationality is not something apart from our animal bodies, but instead emerges from, and is shaped by our bodily interaction with nature. The so called "mind" and "body," Johnson (2007: 12) argues, are merely "abstracted aspects of the flow of organism-environment interactions". The poem "Walking" shows in particular how mind, embodied mind, *works* or *walks*.

The first line, "In my head I am", suggests that the "I" (my thinking) is physically located in my brain, but it also reminds us of the Descartes's epistemological principle of the *cogito* ("I think, therefore I am"). But the following line confirms that "I am / walking...I am not / in my head". Cognition is not some inner process performed by 'mind,' but rather is a form of embodied action. The speaker's direction ("where") therefore is not a place of speculation, not just to be "thought of", but is "there to walk", something to be discovered through his walking. He says, "I *think, feel* / as my feet do [act]" (italics mine), meaning that thinking and feeling come into beings only through his embodied engagement with environment. All these actions or interactions allow him to reach "one" end of his intention, not *the* end, the final destination, which does not exist in this continual flow of reality. The poem suggests that human mind is not contained in the body, but emerges from and co-evolves with the body. According to Johnson (2007: 279), a human being is a "body-mind, that is, an organic, continually developing process of events". In this regard, Altieri (1978: 516) says "what [Creeley's] poem means depends entirely on its own activity as it thematically and linguistically presents a process of thinking about its own problems and movements". The poem is about *thinking* by calling attention to itself as instance of the (bodily) process, "Walking".

Creeley's poem is indeed an impressive poetic illustration of the kinetic

energy of the colliding particles, in which various patterns, or particles, are formed and dissolved. Matter does not exist with certainty at definite places, but rather shows "tendencies to exist" (Capra 2010, p. 68). In this regards, Fass (1978: 157) made an interesting observation that mainly through repetition of certain key words, "self-reflecting and mutually self-effacing," Creeley's poem reduces "the referential meaning of words almost to nothing or nonexistence so that the words come alive," existing through themselves, with full of creative potentials. This is Creeley's "self-annihilating creativity" (Fass 1978: 58). Creeley's poems forever partake of the unceasing dance of self-annihilation and creation of the subatomic particles in quantum physics. According to Vernon (1978: 313), Creeley's poems are so provisional, and their relationship to existence so risky that "they could easily pass out of existence themselves, without leaving a trace--or, unexpectedly, existence could suddenly pass into and occupy them". The famous poem, "I Know a Man" (Creeley 1982: 132) vividly demonstrates the dynamic interplay of quantum field, in which particles are created and destroyed without end in a continual variation of energy patterns.

As I sd to my
friend, because I am
always talking, -- John, I

sd, which was not his
name, the darkness sur-
rounds us, what

can we do against
it, or else, shall we &
why not, buy a goddamn big car,

drive, he sd, for
christ's sake, look
out where yr going.

In the poem, the internal monologues are like virtual particles in quantum

physics. As Vernon (1978: 313) observes, the monologues, "Which was not / his name", suggests that we are not in "reality", but rather in an activity of words ("because I am /always talking"—another monologue). But this activity of words, however provisional, *is* a reality. In fact, it gives birth to a literal car: "drive, he sd". All the occasions and events come into full existence only through their interaction, particularly mediated by the subtle exchange of the internal monologues, much like the transient, short-lived virtual particles, which appear "internal lines" in the Feynman diagram. Particularly, Creeley attempts, in his poems, to follow the peculiar shape and movement of the word as it is released from the body. The breathtaking driving situation dramatizes Creeley's inner struggle, in the moment of darkness, to confront the language (the road) directly, with his most instinctive biological rhythm and impulse. The unexpected break, "the darkness sur- / rounds us", implies the speaker's almost suffocating and breathless situation in which he is led to struggle to hit the road directly responding to each condition before him. The poet is simply moving himself word after word until the arrival pronounces the structure of how he has been moving. Perhaps, this is the way we exist, according to David Lee, by virtue of "coupling our bodies constantly to the environment through action." "Perception is necessary for controlling movement just as movement is necessary for obtaining perceptual information. Perception and movement compose a cycle.... [So] we are what we do" (as cited in Johnson 2007: 51).

Rheomode and Emotion-literal

Creeley's poetry makes us aware of the words he is using as things--their *function* in the linguistic context of the poem--as much as of the external reality they purport to describe. This is an extraordinary vision of unity inherent in the field concept of reality. For this reason, what language *does* participates in the formation of what it says and vice versa. In his introduction to *Words*, Creeley (1982: 261) says, "Words will not say anything more than they do". They have "meaning" in that they do "exist through themselves." Therefore, "a poem ... exist[s] in words as primarily the fact of its own activity (Creeley 1970: 54). Quantum theory forces us to see the universe not as a collection of physical objects, but rather as a complicated

web of relations between the various parts of a unified whole. All of this can be summed up by quantum wholeness proposed by David Bohm (1980), according to whom the world cannot be analyzed into undependably and separately existent parts. There is an unbroken internal relatedness of all things, which he calls "implicate order," that appear as separate and relatively independent in the unfolded, or explicate order (Bohm 1996: xxxii). The general process of implicate and explicate ordering is common both to matter and to mind, which are not separate substances but different aspects of one whole and unbroken movement, David Bohm (1980) has himself crossed over into language, or linguistics, to suggest a model called "rheomode", which would capture the unbroken wholeness. The aim of rheomode is to make the mental representation transparent to itself, meaning that the language, while calling attention to the reality *without*, should be made relevant to the reality *within*. The language does not simply represent the external reality but present or enact itself as an inherent part of the total reality. Language has its own physiological function which, according to Bohm, could be or should be made relevant to its meaning. From this perspective, meaning is not a matter of what the word says at a semantic level, but a matter of the rheomodic "truth" in which our body-based understanding of a word fits our body-based understanding of a situation. What is significant about the rheomode is that it is self-reflective, i.e., its verbs call attention to themselves as verbs, as language constructs of being or becoming (language), even in the act of calling attention to an action or a state of being (content). Bohm (1980: 35) says,

The spontaneous and unrestricted act of lifting into attention any content whatsoever, which includes the lifting into attention of the question of whether this content fits a broader context or not as well as of lifting into attention the very function of calling attention which is initiated by the very itself (language).

This aspect of language has been a most significant feature of Creeley's poetry: self-reflective wholeness, that is, what language does participates in the formation of what it says and vice versa. Even though Creeley's language is not particularly verb-based, all his words --nouns, verbs, even proposi-

tions--'move', that is, interact each other with kinetic energy, in a constant movement of transformation, the activity that is clearly "relevant" to a quantum universe of particles emerging out of the field.

In Creeley's poetry, one can perceive the fit between language and what is going on, between the reality within and without. The content of language and its actual function are seen and *felt* as one. Altieri (2010: 38) calls such Creeley's mode of writing a "conative style", in which "the poem becomes a search for qualities of language that might adjust to the particular situation without the irritating abstraction and generality". What the jagged lines of Creeley's poetry try to capture is the actual experience of qualities or felt sense of the situation, which involves our physiological conditions and emotional contours as well as logical thoughts, and which therefore cannot be structurally determined by concepts nor adequately conveyed in the grammatical propositions with subject-predicate structure. Creeley's poem does not merely develop its theme conceptually. Rather, it pulsates with corporal rhythms and contours of felt experience.

One gets therefore a strong sense that the poet's emotion is especially charged or imbued in the literal activity of language. Emotion is a mental state which the individual reveals through many physiological activities--pulse, respiration, blood pressure, etc. Whatever prompts the emotion is so thoroughly imbricated in the language that there is literally no separation between word and event. Creeley (1970: 28) translates emotion into "emotion-literal", the linguistic relationships which evoke emotion: "The emotion literal in the poem becomes literal in its transmission". As observed in the poem "I Know a Man", Creeley's mind is occupied with its emotional qualities, and with the context in which he is using language. While the poem is full of emotions involved in the urgent driving situation, the emotions are not described, but enacted by the language of the poem, with its internal breaks, monologic interruption, staccato rhythm, all of which are deemed to embody emotional particulars. According to Johnson (2007: 67-8), emotions are fundamental part of human meaning. "They are part of our cognitive engagement with the world... [as] they are integral to our ability to grasp the meaning of a situation and to act appropriately in response to it". In Creeley's poetry, neither thinking nor feeling is recognized as such until their associative patterns are materialized into words and syntactic

structures. To make "emotion literal", for Creeley, is to create a complex of linguistic activities which share the same essential characteristics as that of physiological activities. Creeley's notion of "emotion-literal", Diehl (1978: 340) points out, makes possible two 'literal events' one and at the same time: "the 'emotion' which reside in body, and the 'emotion literal' which resides in language". The felt sense and the linguistic expression are not two independent entities, but they are two dimensions of a single ongoing activity of meaning-making, each one intrinsically related to the other.

Conclusion

Creeley has been deceptively called a minimalist mainly for his terse, spare style with his subject-matter too far removed from the 'great human issues'. However, if he is a minimalist, it is because, in his poems, words do not say more than they *do* in the literal context of the poem, in which an utterance is but a manifestation of the energy involved in the field of composition. In this regard, Creeley was able to create wholly new rhythmic patterns with the language--"the one genuinely original verbal music in the English language in the second half of the twentieth century" (Hass 1987: 391). What Creeley is seeking is the most adequate expression of an 'occasion' in which language is part of the reality it purports to describe. Poetry itself, for Creeley, is the "cry of its occasion" (a line from Stevens' poem 1982: 473), a manifestation or excitation of the "quantum field" perhaps, in which language, thought, body and reality can be made to coincide in mirroring each other's dynamics. In this sense, Bohm's vision of indivisible wholeness and the theory of *embodied* cognition are themselves embodied in Creeley's poetry, in which, as Stamenov (2004: 162) comments on Bohm's rhemode, "reality from within is indistinguishable in its dynamics from reality from without". Creeley has truly revolutionized the whole meaning of language, or the role of the subjective and objective, of mind and body, going beyond the old paradigms of language (representation) and reality. This current study of Creeley's projective verse, though limited in scale to a particular poetic imagination, will serve a vehicle for further exploring how we can bring together the quantum ideas and embodied cognition to examine our art and literature, which will then help us determine the cultural meaning

of scientific discourse.

References

- Altieri, C. 1978. Placing Creeley's Recent Work: A Poetics of Conjecture. *Boundary 2*. 6(1). 513-544.
- . What Does *Echoes Echo*? In: Stephen F. and Steve M. eds. *Form, Power, and Person in Robert Creeley's Life and Work*. Iowa City: University of Iowa Press: 36-49.
- Bohm D. 1996. *On Creativity*. New York: Routledge.
- . 1980. *Wholeness and the Implicate Order*. New York: Routledge.
- Capra, F. 2010. *The Tao of Physics*. Boston: Shambhala Publications Inc..
- Creeley, R. 1982. *The Collected Poems of Robert Creeley: 1945-1975*. Los Angeles: University of California Press.
- . 1970. *A Quick Graph: Collected Notes & Essays*. San Francisco: Four Seasons Foundation.
- Diehl, P. 1978. "The Literal Activity of Robert Creeley." *Boundary 2*. 6(1): 335-346.
- Fass, E. 1978. *Towards a New American Poetics: Essays & Interviews*. Santa Barbara: Black Sparrow Press.
- Fredman, S. 1990. *Poet's Prose: The Crisis in American Verse*. Cambridge: Cambridge University Press.
- Hass, R. 1987. Creeley: His Metric. John W. ed. *Robert Creeley's Life and Work: A Sense of Increment*. Ann Arbor: The University of Michigan Press: 391-400.
- Hayles, N. K. 1984. *The Cosmic Web: Scientific Field Model & Literary Strategies in the 20th Century*. Ithaca: Cornell University Press.
- Heisenberg, W. 1955. *The Physicist's Conception of Nature*. Trans. Arnold Pomerans. New York: Harcourt.
- Johnson, M. 2007. *The Meaning of the Body: Aesthetics of Human Understanding*. Chicago: University of Chicago Press.
- Johnson, M. & Lakoff, G. 2002. Why cognitive linguistics requires embodied realism. *Cognitive Linguistics*. 13: 245 – 263.

Olson, C. 1950. *Selected Writings*. New York: New Directions.

Panda, N.C. 1991. *Maya in Physics*. Delhi: Motilal Banarisdass Publishers.

Stamonov, M. I. 2004. The Rheomode of Language of David Bohm as a Way to Re-construct the Access to Physical Reality. In Gordon G. et al. eds. *Brain and Being: At the Boundary between Science, Philosophy, Language and Arts*. Philadelphia: John Benjamins Pub.: 147-164.

Stevens W. 1982. *The Collected Poems of Wallace Stevens*. New York: Vintage Books.

Vernon, J. 1978. The Cry of Its Occasion: Robert Creeley. *Boundary 2*, 6(1): 309-327.

Telepathy, Hypnosis and the Medium

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Abstract

This paper takes a focused look at psychical research in Germany at the beginning of the 20th century, specifically, on the use of the human medium as tool within a research practice. Placing the focus on the human medium as instrument, allows for the exploration of the telepathic séance situated between scientific and psychical practice. The example of this struggle will be the work of Albert von Schrenck-Notzing, a parapsychologist and strong advocate for the scientific value of telepathic séances.

Keywords telepathy, scientification of psychology, mediation, photography, instrumentation in science



Figure 1.

Spiritualism, psychical research and telepathy

From the mid 19th century, disciplines such as telepathy, hypnotism, telekinesis and mediumship became problematic for experimental psychology. These fields were seen to be part of psychical research, which had ambitions to join the domain of psychology and therefore, to become serious science. Researchers who picked up on those topics were keen on exploring a holistic understanding of mind, body and matter, fighting the materialist explanations of the mind. They saw their work as pioneering in and expanding the domain of psychology, not as a contradiction to it.

Since the first psycho-physical experiments led to results that perception, sensation, and the temporal extension of thought (if not thought itself) were believed to be measurable, scientific research started focusing on the material basis of life and mind and dismissed large areas of human experience. This exclusion was particularly noticeable in psychology where experimentation became increasingly restricted to measuring physiological responses to external stimuli. (Wolffram 2009: 14)

But spiritualists and psychical researchers demanded a consideration of a different order of facts — one in which nonphysical, mental and spiritual forces could cause other mental and even physical events (Coon 1992: 149). Specifically, telepathy had an interesting position in this discourse. Luckhurst, a contemporary expert on 19th century science and literature, claims in “The Invention of Telepathy” (2002) that telepathy had a paradoxical position as a spacial and temporal symbol in society. First, telepathy allowed a distant but also intimate communication, and second, it supported a wider exploration of polytemporality (Luckhurst 2002: 179).

Besides its struggle in the scientific debate, telepathy functioned as a complex boundary object. It provided an entanglement and cross-fertilisation, a corresponding archive of fears, fetishes and phobias, which were surrounded by possible connections between the human and non-human, the material and the impermanent, the living and the dead, and the sane and the insane. These borderline phenomena grabbed the attention of many researchers and scientists.

Establishing psychical research

One prominent figure who advocated for telepathy to be a scientific method, was Baron Albert von Schrenck-Notzing, the ‘ghost baron’. He was ambitiously working on extensive studies on physical mediumship and meant to establish parapsychology as an experimental and laboratory science counting psychical research as part of it. Schrenck-Notzing particularly positioned his work as a response to Wundt’s research. Wundt, a grounding figure in early experimental psychology, had criticised the unscientific execution of séances a few decades previous. His disappointing experiences with the medium Henry Slade strengthened his issues with:

”(...) the role of the medium as experimenter, subject and interpreter; the lack of causality in the experiment; the primitive recording and measurement of events; and of course, the interaction of the medium. (Wolffram 2009: 138)

But Schrenck-Notzing aimed to prove these accusations wrong. His goal was to establish a meticulously documented practice, which should hold up as evidence to prove the seriousness of telepathy and most importantly, the mediums abilities. Therefore, every participant in the Baron’s séances had to provide an experimental protocol. These testimonials recorded the participant’s impressions, noting the medium’s disposition, precautions taken to prevent fraud, and the appearance of any phenomena (Wolffram 2009: 143).

The circle of scholars, artists and intellectuals who participated in Schrenck-Notzing’s séances joined him in pursuing an experimental study of sleepwalking, telepathy and clairvoyance, inspired by the medical schools of Charcot in Paris and Bernheim in Nancy (Wolffram 2009: 54).

In such séances or sittings, a medium was expected to demonstrate how spirits were communicating through their body, which implied and could prove that a person was able to control and switch off one’s mental agency. This happened in a trance-like state, entered either through a self-induced or hypnotic somnambulism (Wolffram 2009: 45). Surprisingly, hypnosis and telepathy were considered by some as actually contradicting practices though their idea and mission was to explore the transfer of mental agency.

But some believed that hypnosis was disabling the medium's paranormal senses. Since it was believed that the hypnotist transfers his mental agency into the subject, this person could therefore not be receptacle to the agency of a spirit.

Another important aspect besides the induction within the telepathic process was the presence of an audience. Observing and documenting the events was essential, since the séance was seen as spectacle of paranormal sensitivity leading to a visual manifestation of spirit in matter.

Ectoplasm and photography as evidence

Schrenck-Notzing had a favourite medium, "Eva Carriere". Due to her extra-ordinary abilities, she was able to continually produce a mysterious-looking "fluid" known as ectoplasm.

Sir Arthur Conan Doyle who often joined séances described ectoplasm as "a viscous, gelatinous substance, which appeared to differ from every known form of matter in that it could solidify." (Doyle 2008: 113)

The invention and visualisation of ectoplasm could have had two important functions. First and most importantly, it functioned as material proof of hidden forces and as evidence in showing that the soul had material components.

It is worth noting that this visualisation of evidence was only possible due to the acknowledgement of photography in the scientific practice. The second function of ectoplasm was in supporting the quality of the human medium itself.

This therefore provided proof that spirits could do more than inhabit the medium's bodies – they could cause physical manifestations. However, mediumship was a competitive business and lots of *fake* mediums developed creative ways of generating sounds and other effects attributed to the appearances of ghosts. These issues actually lead the *authentic* mediums to turn to more drastic measures to prove their connection to the beyond. The idea of ectoplasm was born.



Figure 2.

Since the exteriorisation of ectoplasm seemed to require a state of self-control on the part of the medium, they used its appearance as proof of their actual quality of controlling their mind/body connection. Ectoplasm was not only providing a connection between life and death or between spirit and body, but it was supporting the quality of permeability of the medium and its actual objectivity.

It is important to remember that a medium had to overcome subjective attributes to show that he or she was able to transform into a channelling object of proof. Similar to the way we use technological devices in contemporary research, the idea was to isolate the element of subjectivity from the scientific result. Those tendencies towards lasting and visible proof also hint to the rise and strong bond between science and visual technology. This co-dependency might still lead to a problematic differentiation between results

and effects, which is a problem that not only telepathic séances had. In addition to the qualities of his medium Eva, Schrenck-Notzing used technology in his favour as well. To demonstrate his “scientific” methodology, Schrenck-Notzing employed a battery of eight cameras; two of them stereoscopic, which led to 225 photographs being taken during various stages of the phenomena. The cameras were arranged to take pictures simultaneously in order to record the séance at a number of vantage points (including above and behind the curtain).

One could say that the setting of his séances created a *triangle of mediumship* between the body of the medium, the photographs and ectoplasm – which were all working together to prove the materialisation of spirit.

This could unfortunately not prevent the lack of actual results that had to be compensated with effects. His ambitions become too apparent following the publication of his photographic book “Phenomena of Materialisation” (1920). Some time after its release, several of the “spirit faces” were found to be those of real people whose pictures had appeared in the Paris newspaper, *Le Miroir*.

Psychical research could not prevent the issues around its methodologies which led to increased public humiliations. Around the same time of Schrenck-Notzing's research, secret confessions of mediums became popular, for example in “Confessions of a Medium” (Unknown author 1907/2005) and “Behind the Scenes with Mediums” (Abbott 1912). In those books, mediums (or maybe even the ones who conducted séances) confessed in detail about their specific knowledge in chemistry or physics and how they executed certain tactics during the séances.

Mediums were critical of scientists for being too naïve in searching only for “external” hidden props or apparatuses and in underestimating the mediums ability to influence and direct their focus or attention.

One could argue that mediums themselves were conducting scientific observations on the scientific audience and soon became experts in deception, attention and vision. Although the causality of phenomena they worked on could not be scientifically proven, they managed to conduct a professional analysis of the scientific practice, despite being denied access to it.

Unfortunately, not much background information on the collaborative practice between medium, researcher and photographer could be found. But bringing all that information together gives a new perspective on the experimental setting of telepathy and even hypnosis, one on the explicit knowledge of psychology and expectations in science.

The difference between scientific method and scientific topic

Studying the telepathic séance as a concept enabled a phenomenological analysis of the awareness and strategic intention of the medium, which went beyond the execution of a simple set of tricks but actually unravelled a counter study of the scientific method. What becomes clear is that the line between producing scientific proof and strategically staging how “science” looks like, can be very blurred.

Psychical research or parapsychology could not attach themselves to the scientification of psychology for many reasons. In the case of telepathy, too many critical voices were raised. Some of them by hugely respected experimental psychologists of that time, like Münsterberg and Jastrow. The arguments sounded similar to Wundt’s criticism – a lack of causality in the result, the dominance of the medium over the séance and also no guarantee for its reproducibility and therefore validity.

While the conductance of experiments is changing and improving, the topics of interest seem to reappear through time. Besides the fact that the scientific relevance of telepathy was already dismissed not long after Schrenck-Notzing had fought so hard for it, the interest of science in “mind to mind” transfer or even *ghost imaging* seems to be of actual importance and relevance. Recently, a group of international scientists were able to demonstrate, “the conscious transmission of information between human brains through the intact scalp and without intervention of motor or peripheral or sensory system” (Grau et. al. 2014). The published research entitled “Conscious Brain-to-Brain Communication in Humans Using Non-Invasive Technologies” (Grau et. al. 2014) is considered to be the first scientific evidence of mind-to-mind transmission, which would come very close of what was understood to be telepathy. And again, it is thanks to technological advancements that this topic made its way back into science.

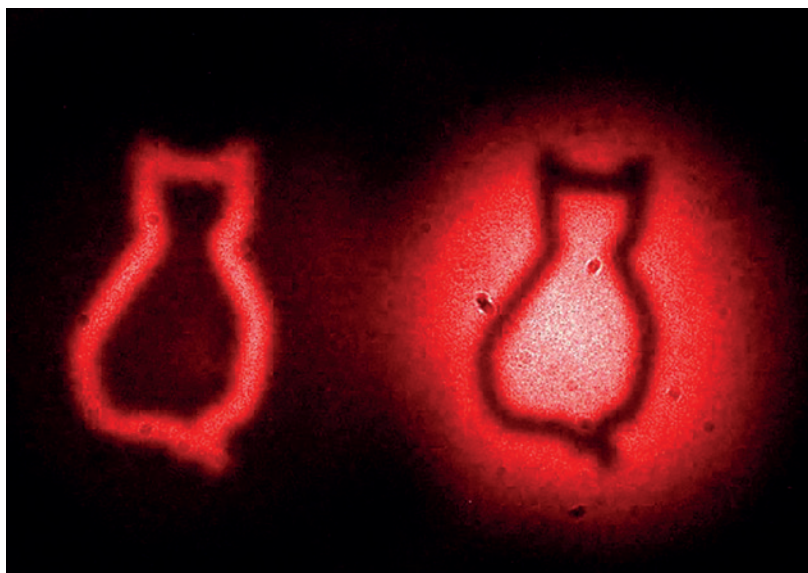


Figure 3.

Similar to telepathy, the idea of spirit photography, is surprisingly still echoing into contemporary experimentation (Vergano 2014). Researchers from the University of Glasgow and the Academy of Sciences in Vienna presented their evidence for an optical paradox of image making in 2014. The physicians managed to produce images that were results of light particles, namely photons, which had never struck an object. This process is contradicting the idea of a conventional camera capturing light that bounces back from an object. In theory, this unlikely possibility is again not a radically new idea or thought. Einstein described this phenomenon as being "spooky action at a distance" (Vergano 2014) but he had no computer technology yet to proof it.

The problem of being scientific

This problem of finding proof or establishing validity is not only witnessed in technology based disciplines but also in psychology. Baker (2015) published an article in *Nature* on the results from psychology's largest reproducibility test, in which she explains the project being "an ambitious effort to

replicate 100 research findings in psychology (...). Results posted online on 24 April, which have not yet been peer-reviewed, suggest that key findings from only 39 of the published studies could be reproduced.” (Baker 2015) Those contemporary experiments show that scientific outcome is not only a question of objective causality or flawless methodology in research, it shows how much the available technology influences what can be “proven” and what is being labelled as “non-scientific”.

In a study from the 1970s, three sociologists of science, Harry Collins, Trevor Pinch and Roy Wallis, took an interest in both historical and contemporary examples to understand what demarcated science from non-science (Gieryn 1983). In their studies of paranormal metal bending, mesmerism, phrenology and parapsychology, they surprisingly discovered that classic distinction criteria, such as falsification and repeatability, were actually not reliable ways of separating science from non-science.

The paper concludes with a reference from the sociologist Thomas Gieryn and the work he published in 1983 on the demarcation of science from other intellectual activities (Gieryn 1983).

He pointed out that we have to keep in mind that the borders of science at any given historical moment are dependent upon factors like: “who is struggling for credibility, what is at risk, in front of which audience and what institutional arena is the knowledge presented” (Gieryn 1983: 790-792).

Preferences

Anonymous (2005): *The confessions of a Medium*. London: Elibron Classics Series.

Abbott, D. (1912): *Behind the scenes with mediums*. Chicago: The Open court publishing company

Baker, M. (2015). *First results from psychology's largest reproducibility test*. Available at: <http://www.nature.com/news/first-results-from-psychology-s-largest-reproducibility-test-1.17433> (Accessed: 09.09.2015)

Coon, D. (1992). *Testing the Limits of Sense and Science. American experimental psychologists combat spiritualism, 1880–1920*. In: *American Psychologist*, Vol. 47(2), pp.143-151.

Doyle, C. A. (2008). *The Edge of the Unknown*. Sweden: Ulwencentuz Media

Gieryn, T. (1983). *Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists*. In: *American Sociological Review*, Vol. 48 (6), pp. 781-795.

Grau, C., Ginhoux, R., Riera, A. et. al. (2014). *Conscious Brain-to-Brain Communication in Humans Using Non-Invasive Technologies the Telepathy*. Available at: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0105225> (Accessed: 10.09.15)

Luckhurst, R. (2002). *The invention of Telepathy. 1870 - 1901*. Oxford: Oxford University Press

Taylor, T. (2008). *The Haunted Museum. The Historic & Haunted Guide to the Supernatural. Baron Albert von Schrenck-Notzing*. Available at: <http://www.prairieghosts.com/baron.html> (Accessed: 05.09.15)

Vergano, D. (2014). *"Spooky" Quantum Entanglement Reveals Invisible Objects*. Available at: <http://news.nationalgeographic.com/news/2014/08/140827-quantum-imaging-cats-undetected-photon-science/> (Accessed: 05.09.15)

Wolffram, H. (2009). *The Stepchildren of Science: Psychical Research and Parapsychology in Germany c. 1870–1939*. Amsterdam: Rodopi Press

Illustrations

Figure 1. “Séance”. Available on: <http://theghostdiaries.com/wp-content/uploads/2013/11/Seance.jpg><https://www.flickr.com/photos/mike1rogers/6422986083/> (Accessed: 01.12.2015)

Figure 2. “Eva Carrière producing ectoplasm”. Available at: <http://publicdomainreview.org/collections/photographs-from-a-seance-with-eva-carriere-1913/> (Accessed: 01.12.15)

Figure 3. “These cat outline etchings are normally invisible to the wavelength of light that made the pictures” (Original image description) © GABRIELA BARRETO LEMOS. Available at: <http://news.nationalgeographic.com/news/2014/08/140827-quantum-imaging-cats-undetected-photon-science/> (Accessed: 01.12.2015)

(How) Does Play Matter?

A Transdisciplinary Approach to Play and its Relation to Neurobiology, Creativity and Deception.

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Abstract

Despite various attempts to define, explain or justify the phenomenon of play, sciences, humanities and the arts have yet to achieve a truly transdisciplinary understanding of the character of playful thinking and playing behaviour. In this paper we propose an experimental, tentative approach towards transdisciplinary understanding. First we discuss three aspects of play that originate from psychology and cognitive sciences: neurobiology, deception and creativity. We then reflect on some of the relationships between these topics from a general perspective. We suggest four exemplary research questions, whose pursuit would require genuinely transdisciplinary approaches. We finally hint at some methodologies that might be deployed to tackle these questions.

Keywords play, neurobiology, deception, creativity, transdisciplinarity

1. Introduction

Children play. Adults play. Animals play. For more than a century, numerous attempts have been made to define, explain or justify play (see Ellis

1973; Sutton-Smith 1997; Henricks 2008). What those theories have largely in common is the assumption of utility and the methodological prerogative of observation. In other words, play is supposed to have a purpose apart from itself and it can be analyzed through observing the players, for example in a laboratory or ethnological setting. However, shifting our attention from the third-person perspective rooted in scientific method to the first-person perspective of the player, a fundamental problem arises. For the player, play must remain inherently purposeless or it is not recognized as play but as work, learning or other activities that aren't pursued for their own sake. Then, if the immediate experience of play escapes utilitarian reasoning, how do we make sense of functional explanations? Where does this seemingly paradoxical nature of play originate?

To start our journey towards a deeper understanding of the nature of play, we give three accounts on aspects of play that originate from psychology and cognitive sciences. Each one is written by one of the authors of this paper and has been extensively discussed with the others to identify common topics and concerns:

Is play locatable in the brain? Neuroscience research is trying to show where exactly play is located in the brain. While incompletely understood (Siviy and Panksepp 2011; Trezza et al. 2010; Vanderschuren et al. 1997), there is evidence to support that brain areas like the prefrontal cortex or the amygdala are involved in social or physical play. While most of the research on play and neurobiology has been conducted with animals, there is also behavioural evidence from research on humans that play seems to have a big impact on cognitive and socioemotional development of children.

Is play morally good? The answer is usually "yes" as play is linked to excitement and fun (Brian and Diana 1984). On the other hand, the common attitude towards deception is rather negative (Ekman 2009). How do play and deception relate to each other? Here, we will point out the "dark side" of play and hint at a "bright side" of deception. We will discuss why the interaction between play and deception is important in terms of children's development. In particular, children who play games that involve deception,

such as hide-and-seek, bluffing and role-play develop important cognitive abilities. On the other hand, we will discuss why dark play in general is attractive to people and how it connects to our real world.

Is play creative? Play provides a fruitful context for creative processes and activities and this has been acknowledged in many theories (e.g. Huizinga 1955; Vygotsky 1978; Piaget 2001; Winnicott 2001) and with small number of empirical research. These findings should be handled carefully as they are coming mostly from correlational studies in which creativity is generally synonymous with divergent thinking. Besides that, lack of knowledge about the overlapping mechanisms involved in play and creativity, as well as the problem of defining these two highly complex constructs are the other issues that should be tackled.

Reflecting on these topics and their connections from a wider perspective will guide us in the second part of the paper towards a possible direction for further research. We propose four exemplary research questions whose pursuit would require genuine transdisciplinary approaches. We finally hint at some methodologies that might be suitable to tackle these questions.

2. Play and neuroscience (Mihaela Taranu)

While play is often considered to be a fun and self-rewarding activity, research claims that play has more implications for our development than just triggering joyful emotions.

The pleasure center of the brain (the nucleus accumbens) is well-established as the critical brain region associated with the neurotransmitter dopamine, which is at the basis of initiating and consolidation of habits, reward-seeking behaviors and addiction (Trezza et al., 2011). In game design for example, this function is well observed and used as a means to motivate players. Vanderschuren et al. (1997) argue that social play can be just as powerful as sex and food urges in triggering brain chemicals that activate the brain's reward mechanism. One study showed that a young rat would push a lever up to 95 times to open a trapdoor in order to play with another rat on the

other side (Trezza et al., 2011), which demonstrates how rewarding playing can be.

Panksepp (1998) argues that the need to play resides in "ancient brain" structures like the thalamus and amygdala, and that play is the main brain's source of joy. In one of his experiments he removed the prefrontal cortex in young rodents. Even though their cognitive abilities were compromised, they continued pouncing, wrestling and chasing, which are typical playful behaviours. According to the author, the time spent on playing strengthens the brain pathways. It is argued that play facilitates the maturation of the inhibitory skills that gradually come to regulate children's impulsive primary-process emotional urges.

An idea promoted by Panksepp (1998) is that the more children are involved in play, the sooner and better they will develop the regulatory functions in the frontal lobe that allow people to inhibit impulsive urges and to focus on the current activity. This idea was later on investigated by Diamond et al. (2007) which showed that playful activities have a positive impact on the development of executive functions. They created a research program called Tools of the Mind and tested its efficacy on four and five-year-old kids. In this study, children played actively by walking around, talking and telling each other stories. When the children were compared to children that were instructed in a traditional way, the former had higher standardized score on subsequent examinations. This indicates that social play is an excellent means for exercising and building up the executive functions as working memory (children must hold their own role and those of others in mind), inhibitory control (children must inhibit acting out of character), and cognitive flexibility (children must flexibly adjust to unexpected twists and turns in the evolving plot).

The same results are also found in animal studies. Social isolation of rats during the juvenile or early adolescent phases produces long-lasting impairments in social capacities and cognitive control of behavior, even after prolonged re-socialization (Pellis and Pellis 2009). Likewise, abnormalities in social play behavior are observed in childhood psychiatric disorders such

as autism and attention deficit/hyperactivity disorder (van Kerkhof et al., 2013).

Pellis et al. (2010) state that there are two hypotheses that explain how the brain and the behaviours of rats develop because of play. The first hypothesis, training-for-the-unexpected, states that animals that play are less affected by unpredictable events (Špinka et al. 2001). This may occur because play somehow dampens the emotional reaction to a novel and unpredictable situation. A major brain structure known to regulate fear and its negative affective states is the amygdala, a bilateral structure that is situated beneath the temporal lobes and under inhibitory control of the prefrontal cortex (PFC) (LeDoux 1996). The PFC moderates the activity of the amygdala which prevents emotional overreaction. Therefore, the experience of play influences directly and indirectly the development of the PFC. This mechanism may be the way in which play helps to teach animals to be more resilient when facing the unpredictable world. The second hypothesis is the extended motor-training which states that play during the juvenile period prepares the motor system of animals for engagement in adult behaviours. In the end, these two converge into one process: play trains animals to be resilient by modifying the neural circuitry that regulates emotional responses. As a result, rats that play as juveniles are more socially competent as adults.

It appears that play is extremely important both in animals and humans for the development of various functions such as acquisition of language, cognitive, socio-emotional and physical development. The implications are important but more effort is needed to fill the gaps in our understanding of the complex phenomenon of play.

3. Play and Deception (Chun-Wei Hsu)

Is play morally good? For most people, play is linked to excitement and fun, while it offers the chance to express their creativity and emotions without any constraints. Play researchers have also tended to focus on play as a fair and pleasant activity that is constructive and socially appropriate rather

than destructive and deviant (Henricks 2008). For example, when children play by piling up building blocks it seems more appropriate than when they destroy what other children have created. Brian and Diana (1984) call these moral biases the “idealization” of play. However, a “dark side of game play” (Mortensen et al. 2015) is manifest in playful encounters and this can be illustrated through the example of deception.

Well-known games such as hide-and-seek, card tricks, role-play, magic, and bluff dice all involve deception. Why do we create these deceitful games, especially for children? How can they benefit from deceptive play? To approach the above questions, we will discuss children’s development in terms of cognitive functions and the allure of dark play in general.

When children younger than four or five years old are playing the game hide-and-seek, something interesting is revealed in their brains. While they keep their eyes closed, they are unable to understand that the seeker can still see them even though they cannot see the seeker. This is happening because they have not developed the ability yet to attribute mental states to others and to understand that others have beliefs in a different view from one’s own. In psychology, this ability is called Theory of Mind (ToM) (Premack and Woodruff 1978). Without this ability, people would find it difficult to interact with each other and the resulting disagreement would harm the sense of cooperation in society (Lee 2013).

Deception is in essence the demonstration of ToM (Lee 2013). To deceive someone successfully, individuals must understand the mental states of others and conduct one’s behavior logically based on their beliefs. Furthermore, ensuring consistencies between the initial lie and subsequent lies requires more sophisticated abilities of ToM to transmit the fake messages without disclosing the facts. For example, in the soap-giving study (Talwar et al. 2007), children received an undesirable gift (i.e. soap) and were questioned about whether they liked the gift. Those children who (untruthfully) gave the answer that they liked the soap, were asked for their reasons. The older children were able to generate more elaborate lies, such as “I like it because I collect soaps” or “we ran out of soaps at home”, which showed an attempt

to ensure their lies are convincing to the listener.

Can children develop the ToM from play? In the previous play studies, researchers have attempted to demonstrate the usefulness of play for individuals and societies. Henricks (2008) pointed that play is a chance for children and adults to develop socially useful ideas, values, skills, and relationships and learn new strategies for dealing with the world. Moreover, play has been seen as a benefit to physical as well as to mental health, and it reminds people of what their bodies and minds can do. According to the history of play studies (Henricks, 2008), children can definitely develop the social skills as they play with others and prepare for the kinds of challenges they will face in more complicated and changing environments. Therefore, play itself can contain the dark element; at the same time, it does facilitate the cognitive development in children while they are playing.

In addition to deception, people also show interest to dark sides of play that involve problematic issues, like war, fighting and cruelty. Dark play allows players to perform aggressive, illegal and immoral behaviors in the playful context. This type of play provides an environment for players to explore something they are forbidden to do in reality. People are allowed adrenaline-generating decision-making within a short period of time and are given ample opportunities to revive if they fail, which is impossible in the real world. Players enjoy the sense of control of their destiny and the immediate feedback in games. In addition, aggressive play does not have to be antisocial, but can be a way of conducting intense and satisfying activities with their peers (Goldstein 1998).

From these discussions, we see that a link between play and morally difficult issues like deception can be established. Is play always good and deception always bad? The concept of dark play blurs this boundary and encourages us to think about play from a different perspective.

4. Play and Creativity (Pinar Oztop)

Play is an important part of our socialization process. This has been rec-

ognized in numerous fields including performance arts, sports, games, hobbies. But, it is still one of the lesser understood phenomena in social sciences. One particular reason that necessitates understanding play better is its connection with creativity. Play provides a fruitful context for creative processes and this has been acknowledged in many theories (e.g. Huizinga 1955; Vygotsky 1978; Piaget 2001; Winnicott 2001). Yet, how these constructs are related with each other is unclear due to lack of consensus in defining those constructs, methodological approach problems and lack of research.

Together with its important role in human development, play is also vital for creativity as it stimulates curiosity, flexible thinking, and improvisation and thus develops problem solving skills, adaptation as well as imitation (Garaigordobil 2006). There have been many studies, carried out with different frameworks, that confirmed that play and creativity are associated and it is even suggested that they are largely overlapping (Russ 2003; Russ and Wallace, 2013). However, although there is solid evidence that play and creativity are related, most of the findings come from correlational studies. In other words: we lack evidence to confirm causal relationships. So it is difficult to predict the direction of the relation between these two constructs. Moreover, most research on play and creativity has focused on creativity only in the forms of divergent thinking, as most scholars believe that this is a highly relevant skill for creativity (Russ and Wallace 2013). However, as divergent thinking is only one of the dimensions of creativity, research findings give us an incomplete picture about its association with play.

It is possible to say that creativity and play are naturally connected through the use of fantasies, symbolism and divergent thinking (Dillon 2009). Yet, it is not very clear through which processes play and creativity are exactly related. Russ (1998, 2003) argues that cognitive and affective processes interconnect these two constructs; namely these are divergent thinking, cognitive flexibility, perspective taking, associative skills, insight, and affective processes like incorporation of affect themes in fantasy and memory, experiencing (mainly positive) emotions and expressing joy in playing and creating (Singer and Singer 1990; Bass et al. 2008; Russ 2013). There is definitely need

for future research to understand the overlaps more extensively. Another difficulty that we face in researching the nature of the relation between play and creativity is the fact that both of these constructs are very complex and there is no consensus over how they can be defined (Johnson 2007). Play constitutes intersections with art, drama, games, language, psychology and culture, and this broadness of play makes it difficult to define. On the other hand creativity is another ill-defined construct and the subjective nature of creativity poses a significant obstacle for deciding whether something or someone is creative or not.

Rhodes (1961/1987) suggested to approach creativity from four different perspectives in his four Ps of creativity theory: product, process, person and pressure. However, there is a tendency in the field to approach creativity through the perspective of product. Creativity in products has been associated with the level of novelty and usefulness and producing something both novel and useful requires accomplishment of a certain level of expertise in the field (Amabile 1982). This is a problematic practice, especially for children who are still in development and learning stage. Trying to judge creativity from the product creates a barrier for them to come up with creative results (Russ 2003). Bateson (2013) argues that creativity only means coming up with a novel behaviour or an idea regardless of its practicality, and it should be distinguished from innovation, which implies practical use of this novelty. One way to make creativity research more applicable for children would be to focus on novelty and leave out the criterion of usefulness. An alternative solution would be to distinguish between eminent creativity and everyday creativity (Johnson 2007). In adults' world, creativity is eminent and socially constructed and it results in both original and useful products. However everyday creativity is personally evaluated, it is original and useful for the person creating it and sometimes for the close network of the person as well. Children are perhaps already creative in daily activities including play (Richards 1993) and play could even be accepted as a natural form of creativity (Fein 1990).

Play and creativity are both highly complex, yet vital constructs. There is a clear overlap and significant relations between these two phenomena, yet

the research findings to prove these connections are still limited and methodologically not very convincing. Likewise, we still have no clear understanding of the mechanisms that are connecting these constructs. Definitions of these complex constructs should be simplified especially when we extend our research to children. Finally, another important advancement in the field would be approaching creativity from a broader perspective rather than only approaching through divergent thinking.

5. Play and Meaning (Michael Straeubig)

In the preceding sections we looked at neurobiological links between play and fun, discussed the phenomena of cheating and dark play and presented a critical assessment on play and creativity. While these approaches describe rather different aspects of play, they are nonetheless based on common premises, which are embodied in Tinbergen's four questions (Tinbergen 1963): "What is it for? How did it develop? How did it evolve? How does it work?" (Bateson and Laland 2013).

In particular, the assumption of functionality that is underlying the scientific method is usually taken for granted without question. A challenge arises however, when we consider the first-person perspective (McGinn 1996) of the player. For the players, play must remain inherently purposeless or it is not experienced as such. If we do something for the sake of an extrinsic reward or an external purpose, the activity cannot be called "play" anymore.

Is there a way to resolve this apparent paradox of play by reconciling utilitarian explanations with the non-utilitarian characteristics of the immediate experience? Can we arrive at a common understanding of different phenomena like rough and tumble play in animals and the free-form playfulness of avant-garde artists? Can play, as has been suggested, merely be equated with fun, or does it indeed "matter" in a comprehensive sense, as play scholar Miguel Sicart (2014) insists? And in particular, is there a deeper meaning behind playful activities?

Maybe we can expect answers from the humanities, namely from the signif-

icant contributions to theories of play by Schiller (1795), Huizinga (1955), Caillois (1961), Sutton-Smith (1997), Spariosu (1989) and from the playful work of DeKoven (2014). Other prominent philosophers, anthropologists and sociologists have mused about play, including Plato, Bateson, Derrida, Gadamer and Wittgenstein. Additionally we can look at playful arts movements like the Situationists and Dada and consider the practice of artists and game designers who create playful experiences.

In short, there is a necessity to integrate the the scientific studies of play with approaches from other faculties. As a cultural phenomenon and as an aesthetic dimension, play must be reflected in the humanities and the arts as much as in the explanation-seeking disciplines. The emerging field of game studies (Mäyrä et al. 2015) promises an opportunity to do so, if it can succeed in developing some kind of “gaming literacy” (Zimmerman 2009).

Yet, taking these questions into an integrated frame of thinking requires transcending disciplinary boundaries. According to Blassnigg and Punt (2013) transdisciplinarity "requires a robust foundation in disciplinary practices" but it "[...] is by necessity informed by the complementary extensions of those methods, views, models and conceptions that the single disciplines in their canonical frameworks and specialisation, and their exchanges among disciplines through interdisciplinary engagement, provide." Some of those extensions that might be useful in this regard are critical reflections on theories (Gigerenzer and Goldstein 1996), bridging neurobiology and psychology through introspection (Varela 1996; Bockelman Reinerman-Jones and Gallagher 2013), discussing biologically "useless" behaviour (Kršiak 2011), systems theory (Luhmann 1996) and exposing artistic practice as research (Frayling 1993; Schwab and Borgdorff 2014).

While these approaches are heterogeneous, the outlook for a pursuit of them is promising: “Ideally, emerging new practices, methods, paradigms consequently lead to a re-evaluation of disciplinary tools and concerns through interactive reflection and knowledge exchange, which can lead to transformative long-term impact on the development of disciplinary practice” (Blassnigg and Punt 2013). We believe that in order to make progress on

play research, bold, experimental approaches are to be preferred over incremental improvements within disciplinary boundaries. Distilled from our discussion above, we therefore propose the following four research questions:

1. Is play, in a deep sense, more fundamental than non-play? This assumption would be corroborated by a confirmation of Panksepp's results on a wider scale. Should cognitive science and artificial intelligence then adapt play as areas of research?
2. What (biological, psychological and sociological) sense does it make to learn "bad" behaviour? What are the moral implications of the "dark sides" of play and creativity?
3. How are creativity and play related? Can play be uncreative? How can we bring these two highly complex constructs closer together?
4. Which directions can we take from the hypothesis that play has no function apart from itself?

6. Summary

Play is a common and yet ill-understood phenomenon. Within some academic environments, it is still considered rather frivolous as opposed to other, more "serious" topics. The opposite viewpoint attributes its importance – both in animals and humans – for the development of various functions such as acquisition of language, cognitive, socio-emotional and physical development. Most often, play research takes place within disciplinary silos.

We have discussed three aspects of play: its location in the brain, its connection with deception and its association with creativity. We feel that in each of these areas of study there are currently more questions than definite answers. We therefore suggest a truly transdisciplinary approach involving the arts, sciences and humanities to support further research of play as an individual experience as well as investigate the role of play for our culture. We have posed four research questions that might drive efforts to fill the wide gaps in our understanding. Pursuing these questions would certainly require to adopt transdisciplinarity to a significant extent. Yet, these efforts

will be rewarded: what we can learn about play is fundamental to our understanding of ourselves. In the words of Miguel Sicart (2015): "Play matters because it's a balancing act between order and chaos, and by dancing that dance, by playing, we are human."

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This paper is dedicated to the memory of Dr. Martha Blassnigg, whose open and friendly manner, kind spirit and intellectual curiosity has and always will set an example for each of us.

8. References

Amabile, T. M. (1982) 'Social psychology of creativity: A consensual assessment technique.' *Journal of Personality and Social Psychology*, 43(5), pp. 997-1013.

Baas, M., De Dreu, C. K. W., & Nijstad, B. A. (2008) 'A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus?' *Psychological Bulletin*, 134, pp. 779-806.

Bateson, P. P. G. (2013) *Play, playfulness, creativity and innovation*. Cambridge; New York: Cambridge University Press.

Bateson, P. and Laland, K. N. (2013) 'Tinbergen's four questions: an appreciation and an update, *Trends in Ecology & Evolution*, 28(12), pp. 712-718.

Bewersdorff, J. (2010) *Glück, Logik und Bluff: Mathematik im Spiel - Methoden, Ergebnisse und Grenzen*. Wiesbaden: Vieweg + Teubner.

Bockelman, P., Reinerman-Jones, L. & Gallagher, S. (2013) 'Methodological lessons in neurophenomenology: Review of a baseline study and recommendations for research approaches', *Frontiers in Human Neuroscience*, 7.

- Caillois, R. (1961) *Man, play, and games*. Urbana: University of Illinois Press.
- Diamond, A., Barnett, W.S., Thomas, J. & Munro, S. (2007) 'Preschool program improves cognitive control', *Science*, 318, pp. 1387-1388.
- Dillon, J. (2009) *Play, creativity, emotion regulation, and executive functioning* (Master's Thesis). Case Western Reserve University, Cleveland, OH.
- Ellis, M. J. (1973) *Why people play*. Englewood Cliffs, N.J: Prentice-Hall.
- Ekman, P. (2009). *Telling Lies: Clues to Deceit in the Marketplace, Politics, and Marriage* (Revised Edition). WW Norton & Company.
- Fein, G. (eds) (1987) *Pretend play: creativity and consciousness*. In P. Gorlitz & J. Wohwill, Curiosity, Imagination, and Play. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Frayling, C. (1993) *Research in art and design*. London: Royal College of Art.
- Lee, K. (2013) 'Little liars: Development of verbal deception in children'. *Child development perspectives*, 7(2), 91-96.
- Garaigordobil, M. (2006) 'Intervention in creativity with children aged 10 and 11 years: Impact of a play program on verbal and graphic-figural creativity'. *Creativity Research Journal*, 18(3), pp. 329-345.
- Gigerenzer, G. and Goldstein, D. G. (1996) 'Mind as computer: Birth of a metaphor', *Creativity Research Journal*, 9(2-3), pp. 131-144.
- Gute, D. and Gute, G. (2015) *How creativity works in the brain*. National Endowment for the Arts.
- Goldstein, Jeffrey. (1998) 'Immortal Kombat: War toys and violent video games.' *Why we watch: The attractions of violent entertainment*, pp. 53-68.
- Held, S. D. E. and Špinka, M. (2011) 'Animal play and animal welfare', *Animal Behaviour*, 81(5), pp. 891-899.
- Henricks, T. (2008) 'The Nature of Play', *American Journal of Play*, 1(2), pp. 157-180.
- Huizinga, J. (1955) *Homo ludens: A study of the play element in culture*. Boston, MA: Beacon Press.
- Johnson, J. (2007) 'Play and Creativity', Invited address for 'The International Confer-

ence of Play and Creativity, National University of Tainan, Taiwan, May 30.

Kršiak, M. (2011) 'Tinbergen's four questions, biologically useless behavior and humanistic ethology', *Activitas Nervosa Superior Rediviva*, 53(3), pp. 103–106.

Luhmann, N. (1996) *Social systems*. Stanford, Calif: Stanford University Press (Writing science).

Mainemelis, C. and Ronson, S. (2006) 'Ideas are Born in Fields of Play: Towards a Theory of Play and Creativity in Organizational Settings'. *Research in Organizational Behavior*, 27(6), pp. 81–131.

McGinn, C. (1996) *The character of mind: an introduction to the philosophy of mind*. 2nd ed. Oxford ; New York: Oxford University Press.

Mortensen, T.E., Linderoth, J. and Brown, A.M. (eds) (2015) *The Dark Side of Game Play: Controversial Issues in Playful Environments*. Routledge.

Panksepp, J. (1981). 'The ontogeny of play in rats.' *Developmental Psychobiology* 14, pp. 327–332.

Panksepp J, Normansell L, Cox JF. & Siviy SM. (1994) 'Effects of neonatal decortication on the social play of juvenile rats.' *Physiology and Behaviour* 56, pp. 429–443.

Panksepp, J. (2007) 'Can play diminish ADHD and facilitate the construction of the social brain?' *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, 16(2), pp. 57–66.

Pellis, S.M. and Pellis V.C. (2009) *The Playful Brain*. OneWorld Publications: Oxford, UK.

Pellis, S.M., Pellis, V.C. & Bell, H.C. (2010) 'The function of play in the development of the social brain'. *American Journal of Play*, 2(3), pp.278-298.

Pellis, S. M., Pellis, V. C. & Himmler, B. T. (2014). 'How play makes for a more adaptable brain'. *American Journal of Play*. 7(1), pp. 73-98

Piaget, J. (2001) *Play, dreams, and imitation in childhood*. London, UK: Routledge (Original work published 1951)

Premack, D. and Woodruff, G. (1978). 'Does the chimpanzee have a theory of mind?' *Behavioral and brain sciences*, 1(4), pp. 515-526.

Punt, M. and Blassnigg, M. (2013) *Transdisciplinarity: Challenges, Approaches and Op-*

portunities at the Cusp of History. Plymouth University.

Richards, R. (1993) 'Everyday creativity, eminent creativity, and psychopathology.' *Psychological Inquiry*, 4, pp. 212–217.

Rhodes, M. (eds) (1961/1987) *An analysis of creativity*. In S. G. Isaksen , *Frontiers of creativity research: Beyond the basics*, Buffalo, NY: Bearly, (pp. 216–222).

Russ, S. W. (1998) 'Play, creativity and adaptive functioning: Implications for play interventions'. *Journal of Clinical Child Psychology*, 27, pp. 469–480

Russ, S. W. (2003) 'Play and Creativity: Developmental issues.' *Scandinavian Journal of Educational Research*, 47(3), pp. 291–303.

Russ, S. W. and Wallace, C. E. (2013) 'Pretend play and creative processes'. *The American Journal of Play*, 6(1), pp. 136–148.

Schwab, M. and Borgdorff, H. (eds) (2014) *The Exposition of artistic research: publishing art in academia*. Leiden: Leiden University Press.

Sicart, M. (2014) *Play matters*. Cambridge, Massachusetts: The MIT Press.

Sicart, M. (2015) 'About the Book', *Play Matters*. Available at: <http://www.playmatters.cc/book/sample-page/> (Accessed: 10 December 2015).

Siviy S.M. and Panksepp J. (2011) 'In search of the neurobiological substrates for social playfulness in mammalian brains.' *Neuroscience and Biobehavioral Review*, 35, 1821–1830.

Singer, D. G. and Singer, J. L. (1990). *The house of make-believe: Children's play and the developing imagination*. Cambridge, MA: Harvard University Press

Sodian, B. (1991). 'The development of deception in young children'. *British Journal of Developmental Psychology*, 9(1), 173-188.

Spariosu, M. (1989) *Dionysus reborn: play and the aesthetic dimension in modern philosophical and scientific discourse*. Ithaca, N.Y: Cornell University Press.

Sutton-Smith, B. and Kelly-Byrne, D. (1984). 'The idealization of play.' *Play in animals and humans*, pp. 305-321.

Sutton-Smith, B. (1997) *The ambiguity of play*. Cambridge, Mass.: Harvard University Press. Available at: <http://site.ebrary.com/id/10326093> (Accessed: 19 September 2014).

- Talwar, V., Murphy, S. M., & Lee, K. (2007). 'White lie-telling in children for politeness purposes.' *International journal of behavioral development*, 31(1), pp. 1-11.
- Tinbergen, N. (1963) 'On Aims and Methods of Ethology', *Zeitschrift für Tierpsychologie*, 20(4), pp. 410–433.
- Trezza V., Baarendse PJ. & Vanderschuren LJ. (2010) 'The pleasures of play: pharmacological insights into social reward mechanisms.' *Trends in Pharmacology Science*, 31, pp. 463–469.
- Trezza V., Damsteegt R., Achterberg EJM. & Vanderschuren LJ. (2011) 'Nucleus accumbens mu-opioid receptors mediate social reward.' *Journal of Neuroscience* 31, pp. 6362–6370.
- Trivers, R. (2011). *The folly of fools: The logic of deceit and self-deception in human life*: Basic Books.
- Varela, F. J. (1996) 'Neurophenomenology: A methodological remedy for the hard problem', *Journal of consciousness studies*, 3(4), pp. 330–349.
- Van Kerkhof, L. W., Damsteegt, R., Trezza, V., Voorn, P. & Vanderschuren, L. J. (2013) 'Social Play Behavior in Adolescent Rats is Mediated by Functional Activity in Medial Prefrontal Cortex and Striatum.' *Neuropsychopharmacology*, 38(10), pp. 1899–1909.
- Vanderschuren, L. J., Niesink, R. J. & Van Pee, J. M. (1997) 'The neurobiology of social play behavior in rats.' *Neuroscience & Biobehavioral Reviews*, 21(3), pp. 309-326.
- Vygotsky, L. S. (1978) *Mind in society*. Cambridge, MA: Harvard University Press.
- Winnicott, D. W. (2001) *Playing and reality*. London, UK: Brunner-Routledge

Cognitive Innovation in Mathematics

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Abstract

What is the nature of cognitive innovation in mathematics? To answer this, it is important to understand the nature of mathematics, its domain and scope, and the structure of its discourse. Mathematics, right from early times, has been one of the most important disciplines and has served as a model for other subjects like philosophy and the sciences. At the same time, it is also perhaps most closely related to certain themes in art. In this talk, I will argue that this ambiguous position of mathematics as a discipline influences not only the cognition of mathematical entities and structure, but also its performative modes of creativity. In particular, I will focus on the role of pictorial cognition and visual metaphors in the creative processes of mathematical thinking since it also allows us to understand what is special to the creative processes of manipulating and playing with symbols.

The nature of mathematics

Mathematics like all other disciplines can be characterized largely by two domains: its ontology and its methodology. Like in other disciplines these two domains – of objects and what we do with them – are not necessarily independent of each other. I will argue in the course of this paper that the methodology we choose for a discipline also goes to define the objects of that discipline. This ontology-methodology description is similar to the object-process description of the world. It may seem that what is special to

mathematics is its capacity to create its own objects in contrast to natural objects that are found in the world. But even this view is a simplified picture and ignores the complexity of how objects of discourse are created from the given, ordinary objects of the world. Science creates its own objects of scientific analysis and it rarely takes a 'given' object as its object of analysis. The naïve perceptual object has to be modified for scientific enquiry and thus 'prepared' as a scientific object. One might say that the same happens for mathematical objects too, at least for those objects like numbers and sets. In this paper, I will argue that one of the best examples of cognitive innovation lies in the creation of mathematical objects through a specific method of writing symbols.

The commonly discussed objects in mathematics are numbers, sets, points, lines, figures, matrices, infinitesimals, infinity, groups, rings, variables and so on. How are these objects imagined and created? Is it only a process of creative, individual imagination or something more? While mathematical objects are special and essential to the discourse, most often mathematics is understood as a process, as a relational activity in which these objects play a secondary role. Operations are also special to mathematics in comparison with other disciplines and these operations exemplify the process nature of mathematics. The basic operations of arithmetic (addition, subtraction, multiplication and division) lead to other kinds of operations in different domains. Sometimes these operations are more complex operations of the basic arithmetic operations – for example, group multiplication can be defined for two groups but it is a more complex combination of simpler arithmetic multiplications. Mappings are another set of operations which can range from simple matching to more complex operations. Operations exemplify the processes of mathematical action and are the path towards creation of new mathematical propositions and statements. This process can perhaps be understood in the following manner: mathematical objects are created first and operations are the means by which the properties of these objects are discovered. Equally, new mathematical objects can be created while 'playing' around with operations on known mathematical objects or by discovering new operations. The ontology of discursive objects is very much related to methodology since methodology is used not just to create knowledge of objects but also to create objects of discourse.

Such cognitive innovations are perhaps common to all disciplines but in the case of mathematics there is a special component which is related to the pictorial cognition of symbols. Symbols are the building bricks used to build complex mathematical objects and creative innovation occurs in both these domains of objects and operations.

While these objects and operations figure dominantly in mathematics there is another term that is perhaps the most important concept in mathematics, one which regulates and unifies the different disciplines of mathematics. This symbol is the = symbol that functions as a master signifier of the discourse. Everything that is created in mathematics has to perforce obey the constraints of the = sign, a constraint that completely regulates mathematics to the extent that Wittgenstein was moved to remark that all of mathematics is a tautology, an empty expression of self-equality of mathematical terms. But this self-equality, the claim that $A = A$, is indeed the most important regulative principle of mathematics and objects and operations have to necessarily conform to this principle.

Creation of concepts that are special to a particular discourse is an important way by which discourses distinguish oneself from another. Common-place concepts get modified in special ways in order to get accommodated into a particular discipline. For example, the concept of nature was widely used much before the development of modern science. However, the creation of the unique discourse of modern science depends to a great extent on the way this concept gets modified and made amenable to science. Among other things, the notion of the 'laws of nature' along with the idea of nature as the final legitimization for scientific truth are special characteristics that are added to the earlier idea of nature in order to take that concept into the scientific discourse (Daston 2014, Henry 2004). Similarly, the formation of concepts in social sciences is influenced both by some pre-given ontology as well as one that is amenable to the methodological constraints of these disciplines. In the same way, mathematical concepts and objects mark out the uniqueness of this discipline and are created in various interesting ways, some of which may refer to the world outside but much originating from the written and discursive practices of this discipline.

A philosophical understanding of mathematics has placed greater emphasis on the ontology and foundations of mathematics. The standard mod-

els that describe mathematics such as Platonism, Intuitionism or Formalism give different accounts of the nature of mathematics. Ontological questions are important in the first two views while formalism is closer to the practice of mathematics. The recent trend of pluralism in mathematics argues that these different ways of understanding mathematics are not incompatible and are necessary to understand the various facets of mathematics both as a discipline and as a practice. Friend (2014, p.2) points out that pluralism in mathematics can be broken up into the foundational, methodological, epistemological and alethic. Moreover, she argues that the pluralist “takes seriously the possibility that there are several, together inconsistent, foundations for mathematics” (ibid., p. 24). And further suggests that “Each mathematical theory, which is powerful enough to give a perspective on quite a lot of mathematics, will have its philosophical sins and virtues. There is insufficient evidence to think that there is an absolute perspective that is best either philosophically or mathematically” (ibid., p. 25).

Quintessential mathematical objects are language-terms and specifically are written symbolic forms. While there may be mathematical objects like numbers which are not restricted to symbolic or language forms, ‘real’ mathematics begins with objects that are visually representable in unique ways. In fact, I would even go to the extent of saying that numbers per se are not really mathematical except in their unique modes of representation as they are in principle available to a domain outside mathematics.

If we look at mathematical objects like sets and matrices, we can already see the importance of visual cognition, which is an attempt to correctly and pictorially match the mathematical concept through graphic forms. A set is a collection and the two ends of a bracket pictorially capture this simple idea of enfolding and collecting together. Matrices are a pictorial extension of the representation of a set. In a matrix, 2 by 2 for example, four elements are collected together but in a particular order – an order not present in the representation of a set. By its very picturing, a matrix has elements ordered in rows and columns. To take this ‘pictorial object’ into mathematics involves describing a certain set of operations that can be done with the object. In this sense, the operations that define the uniqueness of mathematics functions like the method of mathematics and the objects it creates using this methodology become the ontology of mathematics.

So the central point about the ontology of mathematics is this: it is possible to understand the practice of mathematics best by postulating that the objects of mathematics are primarily ‘pictorial objects’ – they are neither objects as we understand them in the common sense of the term or pictures of some already pre-given objects. Thus, the most important cognitive challenge is to find ways to encode the relation between symbolic writing and the domain of mathematical objects and operations.

Mathematical Cognition

Mathematics is one of the most fertile areas of innovation. The discipline has grown rapidly and has branched out into many sub-disciplines. Some of these sub-disciplines seem to have little in common with each other and thus raises the question of whether it is possible to find a common, homogenous understanding of mathematics in all these cases. One answer to this is that what is really common to almost all the vast amount of mathematics is the creative use of the symbolic domain, the notion of operators which allow actions to be performed on these symbols and finally the = sign. In other words, the coherency of mathematics is best represented through its discursive structure and not necessarily through certain foundational, ontological or epistemological claims.

Mathematical practice is one of the best examples of a constant creation of the new – new results, new theorems, new proofs, new ‘objects’, new sub-disciplines and so on. How can we understand this process of fertile creation of the new in this discipline? Is it something related to the special creativity of individual mathematicians, the idea of genius, a social and institutional process or a mixture of many such factors? In what follows, I will restrict myself to a particular mode of creative ‘doing’ of mathematics which raises new and interesting questions about the nature of mathematics itself. The nature of mathematical creativity and the creation of new mathematics have always been an important part of the mathematical imagination. There has also been growing interest in understanding mathematical cognition as something more than a purely mental activity. For example, Menary (2015) points out that classical approaches to cognition are now being replaced by more complex understanding of cognitive processes. The approach of cogni-

tive integration is a good example of an integrated approach towards understanding mathematical cognition. According to this approach, cognition is understood in terms of “multiple cognitive layers where neural, bodily, and environmental processes all conspire to complete cognitive tasks” (Menary 2015, p. 2). So cognition is not understood merely as a brain process but as a combination of ‘the brain, body and the environment’. “Cognitive integration is a model of how our minds become enculturated. Enculturation rests in the acquisition of cultural practices that are cognitive in nature.” (ibid., p. 4)

Mathematics has historically been linked to rational thought, as something beyond and independent of the nature of the world or our experiences with it. It has been dominantly understood over time as having nothing or little to do with human, bodily action. Although the act of aggregation has been acknowledged as the foundation for counting (at least for those numbers which could be counted through our fingers), the growth and complexity of the mathematical discourse seems to have little to do with specific bodily acts. But embodied theories of mathematical cognition attempt to recapture cognitive processes that are in some sense fundamentally related to specific embodied action. There is a very good reason for holding this view when we look at mathematical writing. Right from its origins, the uniqueness of mathematics has always been in the special forms of writing that characterizes its discourse. While one can explain this uniqueness of writing practices of mathematics as attempts to represent the unique ontology of mathematical objects it is not enough to explain the rich discursive practice of mathematics. Essentially, mathematics is writing and mathematical knowledge arises as much from creative practices of doodling and writing as much as following rules of operations. But what is the impulse to these cognitive practices of writing? Is it to be located entirely in the individual, entirely in the rational processes of the individual?

If we focus on the nature of mathematical discourse (and not on the metaphysics of its objects and mathematical truth) then we can immediately notice the connection between this discourse and embodied and social human practices. First of all, the symbolic world which characterizes mathematical writing is deeply indebted to bodily practices as well as to the fact that these systems of writing appear as social systems. Thus, it is not surprising

to find that Menary draws on the writing modes of mathematics including graphs, diagrams, symbols and language in order to argue that “Cognitive practices are enacted by creating and manipulating informational structures in public space.” He goes on to add that such practices are “public, and they are also embodied and enacted. We embody practices: they become the ways in which we act, think, and live” (ibid., p. 4). As mentioned above, the connection between the act of counting and aggregating is basic to mathematical cognition. Even for those who want to describe mathematics as something beyond embodied and social practices, this primitive notion of mathematics is largely acceptable.

Menary further explores the claim that there is a “the phylogenetic basis of mathematical cognition” which is in “our shared sense of quantity and our ability to estimate the size of small sets by making approximate judgments of the size of the set” (ibid., p. 11). But this account is not enough “because precise mathematics depends upon a very recent and acquired public system of exact and discrete mathematical thinking” (11). Thus the shift away from individual-centered accounts of mathematical creativity is possible by recognizing that there is a ‘public system’ of mathematical thinking that is catalyzed in various ways, including the rich domain of symbolic representation and manipulation. Menary then goes on to suggest that mathematical cognition should be seen as enculturation where enculturation is the mechanism by which we move from this “ancient capacity for numerosity” to modern mathematical thinking. This is the evidence, according to him, for “analogical and non-linguistic capacity to recognize quantity and number” (ibid., p. 11).

Menary’s argument is based on distinguishing between two systems that play a role in mathematical cognition. One is the ancient systems of numerosity which are approximate and the newer system of “digital representations and operations” which are digital and ‘precise’. Symbols play this important cultural role since they arise as products of cultural practices.

The importance of this cultural innovation is quite profound. As Menary argues, “Symbolic number systems and sequential algorithms allow for mathematical and cognitive novelty. Once we have a public system, all manner of exotic numbers and operations can be discovered: negative numbers, square roots, zero, sets, and so on. Its importance lies in the ability to per-

form computations that cannot be performed by ancient neural functions for numerosity. For example, the neural circuits responsible for numerosity cannot (on their own) represent -3 or $\sqrt{54}$, and yet this is simply represented in terms of public mathematical symbols” (ibid., p. 15).

While Menary’s arguments open up new spaces for understanding mathematical cognition, particularly in the emphasis on its embodied and public nature, they are focused too narrowly on the number systems and their operations. In doing so, a larger world of mathematical imagination is lost since there is much in the use of symbols in mathematics that raise fundamentally important questions of representation, the domain of mathematical action and so on. It is also the case that the use of symbols in mathematics is definitely different from their use in logic or in ordinary language since language itself is only a system of symbols and we need to account for that (Sarukkai 2005).

Cognitive Innovation in mathematics

In an Editorial, Gummerum and Denham (2014) discuss the nature of cognitive innovation. They note that innovation and creativity have common elements of exploration, curiosity and manipulation. We constantly acquire new skills and knowledge, and an account of this holistic view of creativity and innovation they call cognitive innovation: “Cognitive innovation consists of an endless cycle of exploration, exploitation and explanation; an exploratory process of probing boundaries, selecting which of the countless ideas to exploit and develop further, synthesizing the resulting new insights into explanations of how things are, generating new challenges and questions.”

I will give a brief account of how the manipulation of symbols is related to these notions of cognitive innovation. One view of mathematics sees it as an activity which is very goal oriented to specific results such as the solving of a problem or proving a result. Such focused and goal-oriented model of action, one which is transmitted constantly through early mathematics education, is often not the case in actual mathematical practice. Doing mathematics is to indulge in exploration and play, a constant attempt to probe boundaries. But this doing of mathematics is not an exploration of

new Platonic objects but is more about certain forms of conceptual imagination, employing visual metaphors and symbolic doodling. All these are particularly obvious when we consider the ways by which mathematics gets applied in the sciences but it is my contention that a careful study of how mathematics is done by mathematicians will also illustrate these features of cognitive innovation in mathematics.

My larger claim is that innovation in symbolic writing is an important component of cognitive innovation in mathematics. This innovation is primarily made possible through pictorial and linguistic cognition, and by the unique way of representing mathematical objects. Patterns within objects – and thus their properties – are discovered in the way they are graphically represented. To understand these claims, we need to first recognize that symbols in mathematics are far more complex than the primitive idea of a symbol as something which stands for another. Symbols in mathematics are not mere entities which are manipulated according to some mathematical rules but they also catalyze new rules both for manipulation as well as creating new symbols. Through these writing strategies associated with symbols, it is possible to discover new patterns, new properties and new operations. So we can claim that the primary cognitive impulse is visual at the level of the modes of writing mathematics itself. This is richly exemplified in the multi-semiotic strategies of mathematics as in the use of graphs, charts, figures, diagrams and so on. In fact, mathematical texts are richly semiotic and draw upon many different semiotic systems to construct their meaning (Sarukkai 2002, Sarukkai 2003). How does a mathematician read such a text? Does she look for what the text is about, what kind of a narrative unfolds? It is important to recognize that very important innovations in mathematics appear at the moment of creative reading of these multisemiotic texts.

Mathematics is filled with examples to illustrate this. I will use one very common symbolic object to indicate the contours of this argument about cognitive innovation in mathematics. This object is the bracket (Sarukkai 2002). The brackets – symbolized by $()$ – may not really seem to be mathematical objects. They are not like numbers, for example. They are more like an operation but they are also not like mathematical operations such as addition and division. They do not do something to the objects on which the operation is performed. However, they are operations at another

level, at the discursive level manifested as a particular writing strategy of the discourse. Brackets enclose but what they enclose and the meaning of these enclosures differ. A simple use of the brackets is to denote a collection, such as in a set. The brackets represent the collection of some elements. As is well known from set theory, this innocent act of enclosing is not only a writing strategy since the ontology of the object that contains other objects become extremely important. This is most powerfully exemplified in the ontology of null set, a set which has nothing to contain but stakes a claim for its independent existence.

Mathematics abounds in the creative use of the brackets: from a simple representation of a set to more complex use of brackets in set theory, using brackets to indicate a function such as in the expression $f(x)$, using these brackets in an extended manner to create matrices which are enclosures containing rows and columns, or using brackets to name mathematical objects. The use of brackets as an essential part of naming and creating mathematical objects is something which is very special to the cognitive imagination of mathematics and is a process which I have elsewhere referred to as 'alphabetization' (Sarukkai 2002). This is essentially a process of representing mathematical objects as graphemes and not as words. Brackets are essential to the creation of such representations. For example, $f(x)$ is 'one' entity and is not a word like 'fx'. This simple strategy is extended to include objects like cohomology groups which are written like $H_p(M, R)$. The terms within the brackets give information on the specific elements that define this object but the use of the bracket (like that of the superscript) is to indicate a complex but unified object. Important insights into the practice of mathematics which catalyzes new objects, operations and results are often visually encoded in such writing strategies of symbols (including the 'visual clarity' of tensors in the way they are written, which had a great influence on disciplines like theory of relativity) and thus are an extremely important example of cognitive innovation in mathematics. Thus, new ideas are generated in mathematics due to the cognitive use of new forms of visualization, of metaphorical projections, pattern recognitions at the level of writing and so on. Possibilities of new mathematical objects come through manipulation of the symbolic representations just as the decimal system used to represent 1 to 10 automatically opened up new cognitive possibilities of imagining any

large number simply by extending the symbolic writing of numbers. Like symbols, the pictorial elements that are essential to cognitive innovation in mathematics include alphabets of natural language, bracket symbols, subscripts, superscripts and a wide variety of such techniques. Very often these everyday (and embodied) practices of mathematics are often ignored or subsumed under some other weighty narrative of mathematical imagination but to do that is to perhaps miss the most interesting aspects of mathematical creativity which have to do with linguistic and pictorial cognition.

References

- Daston, Lorraine. The naturalistic fallacy is modern, *ISIS* 105 (3), 2014.
- Friend, Michele. *Pluralism in Mathematics: A new position in Philosophy of Mathematics*. Dordrecht: Springer, 2014
- Gummerum, M and S. Denham. Editorial: Cognitive Innovation: From Cell to Society, *Europe's Journal of Psychology*, Vol. 10(4), 586–588, 2014.
- Henry, John. Metaphysics and the Origins of Modern Science: Descartes and the Importance of Laws of Nature, *Early Science and Medicine*, Vol. 9 (2), 2004.
- Menary, Richard. Mathematical Cognition: A case of enculturation. In T. Metzinger & J. M. Windt (Eds). *Open MIND*: 25(T), 2015.
- Sarukkai, Sundar. *Translating the world: Science and language*. Lanham: University Press of America, 2002.
- Sarukkai, Sundar. “Applying mathematics: The paradoxical relation between mathematics, language and reality”, *Economic and Political Weekly* 38 (35), pp. 3662 – 3670, 2003.
- Sarukkai, Sundar. “The use of symbols in mathematics and logic”, in *Essays on the Foundation of Mathematics and Logic*, Vol 2, Ed. Giandomenica Sica. Italy: Polimetrica Publishers, 2005.

Constructivism and the Transition From Representation to Nostalgia in Videogames

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This article will be detailing the transition from my originally proposed project that was featured on the poster presented during the Off the Lip conference to the current state at the time of writing. In the short time since the conference an opportunity presented itself to shift the direction of my project. This saw moving away from the original focus on the aspect of representation to the role of memory and nostalgia. However the potential impact of constructivism on the videogames medium is still present, and will be crucial in understanding nostalgia's influence upon the current state of media form.

Keywords videogames, constructivism, nostalgia, media

The poster that I presented during the conference represented the culmination of where my project had reached. Prior to the start of the conference I had begun writing a new proposal, and it was during this time that it was completed. The conference did not have a dramatic impact upon the direction of the newly proposed project, as it was too late for that, but it did have a subtle influence over the potential direction and how I viewed the overall relevance of it.

September marked six months since having started the MPhil/PhD program, and whilst I was then familiar with the process, the wider aspects of what contributes to the program were somewhat unknown. That is not to

say that when one enters into this that they are unaware of what it comprises of, but participating in a conference, even when not providing a presentation, exposes one to the procedures and mechanisms of sharing and presenting information and ideas.

The original project proposal was looking at “the impact of technological constructivism on representation and diversity in videogames”. Rather than understanding what representation means in terms of mental triggers and subsequent association, the aim was to explain why certain sectors of society were under-portrayed in the videogames medium. The task would then to be to highlight examples that had made positive steps to represent people outside the overrepresented heterosexual white male and provide a case supporting the need for this to continue and how this would strengthen and sustain the medium itself.

However the representation element has since been largely removed. This is not because this does not require further study, quite the opposite, but was an area that I no longer felt confident accurately exploring, as well as struggling to determine whether the focus would be on representation in the videogames themselves or of those who play the videogames. Either focus would have required different methodologies, one that I would be uncomfortable doing, and the other difficult to determine a suitable criteria and selection pool.

By the point of creating the poster the diversity element was becoming more of the priority. The term diversity can be conflated with representation, in that a diverse range of people can be represented. At first this understanding of the word was the one I was using, but from the start of my project I began to equate the meaning of something being diverse to mean the different type of videogames that now exist. That as a result of both technological advancements and creative/cultural shifts new videogame types and experiences now existed. This in turn had a relationship with the potential state of representation in videogames and the medium itself.

This was where the aspect of technological constructivism came in. By

this I mean the social construction of technology (SCOT) which has been developed in works such as Wiebe Bijker's (1997) *Of Bicycles, Bakelites, and Bulbs* that looked at how social structures can influence the development of technology (Klein & Kleinman, 2002). Whereby development can be a process in which groups provide their interpretation and impact upon design. This however does not mean that a superior result will be achieved. This is highlighted in Bijker's study of the bicycle that identified the early designs favoured a form of showmanship that the clientele wanted afforded by the impractical oversized front wheel, rather than the utilitarian design of two wheels of equal size that transformed the bicycle from a means of leisure for the gentry to a form of personal transport for the masses.

However this alone did not seem to be enough to warrant the size of a PhD project, nor did it provide questions that needed answers. That did not mean that technological constructivism was of no interest, but it had to be a part of something more. This was where the brief that was used for my project came in. The theme was history, memory, and memorialisation, which quickly generated ideas for me, in part because I had started to grapple with the role of nostalgia and its impact upon the videogames medium. This provided a suitable link with the brief provided, as well as a jumping off point away from the original project. This resulted in a greater focus on the transition of the medium itself and how external factors were now having a greater impact, which is similar to what I had eventually decided upon beforehand; except now I had a core element to focus around, that being nostalgia. Memory of the past can provide useful points of reference when it comes to product design, just looking at a recent list of gift ideas in which all of the household items look like they could have come from the 1950s is evidence of this. What had become evident was that videogame design was becoming less dependent on technological advancement, and therefore had more availability to recycle elements from its past to appeal to its audience.

Household items are not the only prominent example of this, as there are car lines available today that are updated versions of designs that are half a century old, such as the VW Beetle, Mini, and Fiat 500. Technical elements of car design have changed during that time, but the exterior is the first

thing someone sees and can be a determining factor whether someone buys a specific vehicle, and the familiar designs have become iconic. The iconic designs could generate certain personal memories for individual (a parent might have owned one) or are seen to represent a certain perceived lifestyle that they want to imitate.

More directly comparable though is the issues surrounding the *Star Wars* series. The *Original Trilogy* in terms of its production was pushing the boundaries for special effects at the time, even though it was also using a full orchestra instead of electronic music that was becoming prevalent (especially in the sci-fi genre), and displaying a “future” that was not the clean and sterile setting often presented. The end result has become iconic and is something that different generations have grown up with and holds a special place in the memory of many. When it came to the *Prequel Trilogy* which the fanbase were desperate for as it meant more content from a universe they cared deeply about; most (it seemed) came away disappointed. George Lucas was again trying to move the film medium forward (by ironically) moving away from the constraints of film and utilising digital technology, which he saw as more liberating as it enabled him to realise the vision that he had.

However this resulted in a series of films that had a different tone and style to the *Original Trilogy*, providing a different experience to one that the fanbase expected and desired. They did not share in Lucas’ drive to advance the medium; they wanted a return of the physicality that was present in the previous films instead of the perceived remoteness brought about in the new films. This nostalgic desire by the fanbase has been listened to by Disney (the new owners of the franchise) and has seen a return to the physicality that is considered a key element of the *Original Trilogy*. As a result the forthcoming films are once again being recorded onto film rather than captured digitally, and there is less reliance on Computer Generated (CG) effects, and a return of physical models and puppetry; all in an attempt to provide an authentic experience that draws upon the fanbases memory of the *Original Trilogy*.

Making this distinction was important for me, as I have noticed this trend on a larger scale taking place in the videogames medium. Since the start of home videogame consoles the medium has constantly focused on technological advancement and this has influenced the videogames that we play. Except now the technological development is not advancing at the same pace it once did. The way in which the medium is fragmented into console cycles has been telling of how significant the advancements have been over time. The previous console generation was notable as it lasted for almost a decade, markedly longer than the typical cycle length of 4-5 years. This saw the type of games available start to diversify as the focus on better graphics and more demanding physics became less essential outside of development from the larger studios.

This diversification has seen many smaller developers imputing elements from the videogames they played during their childhood, elements that had been left behind during the evolution of the medium. It makes no technological sense to create games in the style that has been termed “pixel art”, as the visible pixels found in older videogames were the result of technological restrictions, the limit of what could be displayed based on the amount of storage on the cartridge for the program. Today, whilst limits still exist, they far exceed the amount of storage required for such games. Yet in a medium that has been striving towards “realistic graphics” the pixel aesthetic stands out, whilst also appealing to people’s sense of nostalgia.

Meanwhile the larger studios have been dealing with increased costs due to the requirements of what is known as AAA videogames (similar to the Hollywood blockbuster). This has meant it has become more difficult to take risks, therefore nostalgic desires of the players are being taken into consideration when designing games, as well as what games to start developing. EA’s recent *Star Wars Battlefront* relies heavily on nostalgia, drawing only from the *Original Trilogy* and recreating the characters, vehicles, and weapons using the original models from the films; therefore providing an authentic *Star Wars* experience that the fanbase have been demanding. Conversely creating a nostalgic experience, that is also “realistic” in its depiction of content from the series of films.

The interplay between the constructivist influences on the medium as opposed to the assumed determinist understanding of the medium's form will be a key aspect in the forthcoming research. Along with exploring the different ways in which nostalgia can be understood, and how these different understandings therefore impact upon the resulting media form. The impact of nostalgia demonstrates the effects of social constructivism in bringing aspects back to the medium that would otherwise be ignored due to being deemed outdated and having been replaced by newer design features. This can be seen as analogous to Bijker's bicycle in that an aesthetic that has specific connotations has been chosen over a form that is technologically superior.

Nostalgia has been a force that has unexpectedly arisen, which is why the smaller independent developers adopted it much sooner than the larger established studios. Whilst the industry has responded to past dynamic factors, it is difficult to predict determined form when considering contingent factors. But memory could provide a source of ideas for future videogames and be a potential drive of design. The objective will be to discover whether shared collected memory of players has a greater influence, or that a deterministic use of a perceived memory is used to create a media form in the absence of pure technical determinism.

The change in direction that my project has taken is unsurprising given the academic environment that I have been working in. This has shaped my focus based on the strengths and insights of those around me, whilst still retaining my interest into the cultural development of the videogames medium. Memory and its relation to videogames are a developing area and one that is still underexplored within academia. My aim will be to help contribute a new interpretation of the medium utilising the role of nostalgic memory, and provide a base that others can build upon.

References

Bijker, W. E. (1997) *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. MIT Press.

Klein, H. K. & Kleinman, D. L. (2002) 'The Social Construction Of Technology: Structural Considerations'. *Science, Technology & Human Values*, 27 pp 28–52.

Conference Programme 7–11 September 2015

Workshop Schedule

Monday 7 September - Cognovo Project Space (Link Building, 3rd Floor)

10:30	Tea and Coffee	
10:45	Workshop Introduction	
	Workshop Topic	Instructor
11:00	Gender, Archives and Memory in Early Modern England	James Daybell
13:00	Lunch	
14:00	The Art of Consumption: Picturing tuberculosis in alpine sanatoria around 1900	Gemma Blackshaw
16:00 – 17:00	Tea and cake	

Tuesday 8 September - Cognovo Project Space (Link Building, 3rd Floor)

10:00	Tea and Coffee	
	Workshop Topic	Instructor
10:30	Light Image Imagination: Transdisciplinarity and Publishing in the Arts and Humanities	Martha Blassnigg
12:30	Lunch	
13:30	Visual Mediators: Exploring the transactional capabilities of diagrams, maps and schematic notations	Mathew Emmett
15:30	Break	
15:45 – 17:45	Hanging in Dreams on the Back of a Tiger: Lies, Science and the Philosophy of Metaphor	Min Wild
19:30	Conference Dinner at River Cottage, Royal William Yard (pre-registration required)	

Conference Schedule

Wednesday 9 September - Jill Craigie Cinema and Roland Levinsky Crossroads (Roland Levinsky Building)

8:00	Registration, tea, coffee and pastries	
9:00	Welcome	Sue Denham
9:15	Event Spaces of Infinite Perspective	Mathew Emmett, Adam Benjamin, Frank Broz
	Cognitive Innovation and Framing in Documentary Film Practice	Catalin Brylla
	From Conceptual Blending to Procedural Blending: Applying a model of cognition to process in sound art practice	Iris Garrelfs
10:45	Coffee Break	
11:15	Art in Action: Does recreating motion performed during art production help increase appreciation at the time of viewing?	Ben Dyson
	The Contact Sheet in Close Up	Jacqui Knight
	Creativity as Correspondence in Humanitarian Engagement	Pamela Cajilig and Diego S. Maranan
	Electrophysiology of Cinema Spectatorship	Guy Edmonds
	Perception of Intended Emotion in Drawings by Non-artists	Diane Humphrey
12:45	Lunch	
13:45	Plenary: New Forms of Art-Science Collaboration: Case Studies	Roger Malina

Wednesday 9 September continued - Jill Craigie Cinema and Roland Levinsky Crossroads (Roland Levinsky Building)

14:45	<p>The Formational Imaginaries of Space Technology as an Issue of Cognitive Innovation</p> <p>The Affective Embodiment of Testing Tools and Their Influence on Experimental Outcomes</p> <p>Catastrophe, Sense of Crisis, Cultural Expressions</p> <p>(How) Does Play Matter?</p>	<p>Joanna Griffin</p> <p>Agi Haines, Kathryn Francis and Raluca Briazu</p> <p>Yutaka Nakamura</p> <p>Chun-Wei Hsu, Pinar Oztop, Michael Straeubig, Mihaela Taranu</p>
16:45	Break	
17:00	Round table discussion: Manipulating the Human Mind: When experiments get dirty	Kathryn Francis, Ilaria Torre, Chun-Wei Hsu, Raluca Briazu, Chair: Sue Denham
17:30 - 18:30	Poster + session with drinks and nibbles	

Thursday 10 September - Jill Craigie Cinema and Roland Levinsky
Crossroads (Roland Levinsky Building)

8:30	Tea, coffee and pastres	
9:00	Transcending Academic and Epistemic Boundaries: Psychoactive tryptamines and the frontiers of human exploration	Christopher Germann
	Creative Mind and Evolution in Bergson's Philosophy: The self as technology	Martha Blassnigg
	Cognition, Materiality and Salvation: The relationship between objects, people and God in counter-reformation France	Elizabeth Tingle
10:30	Coffee break	
11:00	Musical Imagery: Towards the liberation of imagination	Freya Bailes
	Engagement and Optimal Experiences in Music Education Clases: A case study based on the Orff-Schulwerk approach and Flow Theory	João C. R. Cunha
	A Multidisciplinary Approach to L2 Learning by Illiterate Adults: Multimedia, situational comedy and dyslexia exercises	Abeer Nasser Eddine
	Exploring Creativity Through Creative Artifacts and Group Performances: Analysis of the students' accounts of a Masters programme in innovation, creativity and leadership	Mary Ann Kernan

Thursday 10 September continued - Jill Craigie Cinema and Roland Levinsky Crossroads (Roland Levinsky Building)

13:00	Lunch	
14:00	Plenary: Cognitive Innovation in Mathematics	Sundar Sarukkai
15:00	Evaluating the Affective Potential of a Computer-aided Composition System in 2D	Duncan Williams, Alexis Kirke, Eduardo Miranda
	Towards Modelling Humpback Whale Song Evolution using Multi-agent Systems	Alexis Kirke, Eduardo Miranda, Luke Rendell, Simon Ingram
16:00	Break	
19:00	CogJam with music, performance, and films from Off the Lip presenters and associates at Exile (across the street at 8 Drake Circus)	

Friday 11 September - Jill Craigie Cinema and Roland Levinsky Crossroads (Roland Levinsky Building)

8:30	Coffee and pastries	
9:00	The Pretty Hard Problem of Creativity	Jack McKay Fletcher
	Memory and the New Unconscious	Sowon Park
	Hypnosis, Telepathy and the Modern subject	Eugenia Stamboliev
	Quantum Creativity: Robert Creeley and self-reflective wholeness	Gi Taek Ryoo
11:00	Coffee Break	
11:30	Plenary: Art and the Brain: Plasticity, Embodiment, and the Unclosed Circle	Amy lone

Friday 11 September continued - Jill Craigie Cinema and Roland Levinsky Crossroads (Roland Levinsky Building)

12:30	Lunch	
14:00	Panel discussion: Cognitive Innovation: Roadblocks, challenges and opportunities	Sue Denham, Martha Blassnigg, Hannah Drayson, Sowon Park, Chair: Roger Malina
15:30 - 15:45	Closing Remarks	Michael Punt

Bio's Off The Lip contributors

Martha Blassnigg (08.09.69 – 27.09.15) is co-convenor of Transtechnology Research and Associate Editor for *Leonardo Reviews* (MIT Press), *Leonardo Reviews Quarterly*; Editor-in-Chief for *Transtechnology Research Open Access Papers* and a member of the Leonardo review panel.

Blassnigg is a Cultural and Media Anthropologist, trained in Cultural Anthropology and Philosophy, and parallel in Film and Cinema Studies, with a background in film restoration, documentary filmmaking and photography as research practice. She has completed two documentary films and has previously worked as film restorer at the Netherlands Filmmuseum (now EYE Film Institute Netherlands).

Raluca Briazu, Kathryn Francis and Agi Haines are researchers at CogNovo Plymouth University. Their expertise spans psychology and arts, the core of their work is the subtleties in scenario production. Creating and measuring responses to scenarios using a plethora of experimental techniques, their collaboration aims to compare and connect disciplinary specific methods.

Susan Denham is Professor of Cognitive Neuroscience in the School of Psychology at Plymouth University. She was the founding director of the university's Cognition Institute, a multidisciplinary collaboration between university research centres and international institutions. Her research in auditory cognition and computational models of perception has led to the publication of over 50 papers and the award of a number of EU-funded projects. She currently leads the innovative doctoral training network, CogNovo, a collaboration between Plymouth University and international academic and private sector partners, formulated to take a transdisciplinary perspective on cognitive innovation and creativity.

Edith Doove is a curator, writer and researcher specifically interested in notions of self-organisation, emergence and contingency, cross and trans-disciplinary collaborations. Her curatorial practice started in 1987 in Belgium with making exhibitions in non-commercial spaces, public space and galleries, for a wide range of organisations, and continued in the UK since August 2010.

Since February 2010 Doove is a contributing researcher and part-time PhD-candidate with Transtechnology Research at Plymouth University looking amongst others into the quality of trans-disciplinary collaborations.

Guy Edmonds is CogNovo Research Fellow and a film restorer and archivist with fifteen years experience in the sector having previously worked at the EYE Film Institute (formerly Nederlands Filmmuseum), Christie's Camera and Photographic auctions and The Cinema Museum in London. His writings on the subject of Home Movies and Amateur film have appeared in specialised edited volumes, the academic journal *Film History*, the film magazine *Skrien*, and the *Stichting Amateurfilm* magazine.

Dr Mathew Emmett is an artist and theorist in conceptual architecture specializing in site-responsive installation, sound and interdisciplinary research in situated cognition. Emmett studied at Central Saint Martins, The Bartlett School of Architecture and The Architectural Association. Emmett's practice operates at the interface between alienated environments and visionary dimensions, whilst exploring transdisciplinary practice with new media technologies. Emmett studied under Karlheinz Stockhausen, exhibited in Germany, Switzerland & the Royal Academy, London. Among other collaborations and international commissions Emmett has worked with Eberhard Kranemann (co-founder of Kraftwerk), the dance choreographer Adam Benjamin with projects in Japan, Perception Lab, Germany and the architectural theorist Charles Jencks. Emmett is the cofounder of *Estranged Space* (<http://www.estrangedspace.net>) working on a wide range of sites that include Second World War subterranean bunkers, the Roman Baths, Kaos Theatre, and the Jurassic Coast World Heritage Sites.

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Iris Garrelfs is an artist and composer working across performance, installation and mixed media projects. Her practice draws on improvisation, music, visual art, film, locative media, and photography. She has recently completed her AHRC funded PhD research entitled “From Inputs to Outputs: An investigation of process in sound art practice” at London College of Communication (University of the Arts London) where she also lectures on the BA Sound Art and Design. She is the commissioning editor of the online journal *Reflections on Process in Sound* and the co-curator and director of experimental sound art series *Sprawl*

Chris Germann studied psychology at the Free University of Amsterdam. His bachelor studies experimentally investigated theories of embodied cognition from a neuroscientific perspective. Subsequently, Chris completed a M.Sc. in psychological research methods (with honours distinction) at the University of Plymouth. In collaboration with Prof. Simon Handley, he investigated the effects of ego depletion on syllogistic reasoning in the context of contemporary dual process theories of cognition. Currently, Chris is a Marie-Curie research fellow in the CogNovo doctoral programme at the Cognition Institute of Plymouth University.

Joanna Griffin is an artist and researcher whose current research is based on findings from a long-term collaborative engagement between the scientists working on the *Chandrayaan-1* Moon mission at the Indian Space Research Organisation in Bangalore, an art college, and an extended, mixed constituency including amateur and professional astronomers, communities living near to the space agency, artists, performers and filmmakers. She has been recipient of an International Artists Fellowship at the NASA Space Science Lab, University of California, Berkeley and has produced commissioned work for the Mullard Space Science Lab, University College London.

Diane Humphrey, PhD., Professor Emerita, King’s University College at Western University, has been engaged in research on visual perception since 1969, spanning neuroscience with animals to visual aesthetics with humans. Her most recent area of research concerns the associations between emotion and colour

in drawing and painting by artists and non-artists. She has conducted developmental and aging research from newborns to the elderly and dementia. She has studied psychology, as well as dance, and collaborated on various research projects in England, the United States and Canada.

Amy Ione is an artist, educator, and the Director of The Diatropé Institute. Her latest book is *Art and the Brain: Embodiment, Plasticity, and the Unclosed Circle*. It is scheduled for publication in 2016 (Brill Rodopi).

Abigail Jackson is an MPhil/PhD candidate as part of the Transtechnology Research Group at Plymouth University, and has received AHRC funding via the The 3D3 Centre for Doctoral Training. With an Undergraduate Dance Theatre Degree in Dance Theatre, and a Masters of Research dance both being achieved at Plymouth University her current research has developed into a multidisciplinary project. The research project aims to facilitate expressive movement sessions, in the development of a creative intervention, for children holding a diagnosis of autism, with digital mediation embedded in its investigation. The progression of this project is aligning with research into the increased connection with technology, for the autistic child, as new technologies are introduced to the schooling, and home, environment.

Alexis Kirke is Senior Research Fellow in the Interdisciplinary Centre for Computer Music Research at Plymouth University. He is a Principle Investigator on the three year Leverhulme-funded project "Developing a data-driven multi-agent model for studying humpback whale song", a collaboration with the School of Biology at the University of St. Andrews.

Frank Loesche's research interest currently focuses on the moment people experience finding a solution to a previously unsolvable problem. Since there seems to be a tradition and a tendency to shout out "Eureka" or "Aha" whenever certain problems are solved, the name given to the effect I am interested in is *Eureka! effect* or *Aha moment*. More about my project can be found on the CogNovo website at Unconscious Creativity – The Eureka Moment.

What drives me personally is the interest in problem solving. From my experience the more a person knows and has experienced the more likely she/he is to find solutions to *hard* problems. Having an active interest in programming, design, music, game design, math, and puzzles of any kind myself, I am sometimes amazed how the transfer of knowledge provides unexpected solutions in different domains.

Yutaka Nakamura is an associate professor at Tama Art University in Japan. Trained in the field of cultural anthropology, he has conducted his fieldwork among African-American Muslim communities in Harlem, New York. More recently he started his new project that engages in the cultural expressions and movements in the socio-cultural “margins” both in the US and Japan. His other research topics include violence, social pain and suffering, cultural expressions and movements, modes of communication and discommunication, mechanisms of discrimination and conflicts. Some of his recent publications include: *Zankyou-no Harlem: Street ni ikiru muslim-tachi-no koe* [*Howling Harlem: Voices of Muslims on the Street*], Editorial Republica, Tokyo, 2015. “Yet Another Elysium, Or on Sensibility and Art of Creating Alien Being: Columbia University’s Campus Expansion and the Redrawing of Harlem’s Boundary” in *Fieldwork on “the Liminal Territories”* (Michinobu Niihara ed.), pp.229-283, 2014, and “Archive and Its Discontents: Identity Struggle among African-American Muslims” in *Japanese Journal of Cultural Anthropology*, 78(2), pp.225-244, 2013.

Michael Punt is a Professor of Art and Technology at the University of Plymouth. He is the founding convenor of Transtechnology Research, international co- editor for *Leonardo* and Editor-in-Chief of *Leonardo Reviews* that publishes in excess of 150 reviews each year on science, technology and the arts. He has founded Leonardo Quarterly Reviews, an experimental publishing platform published through MIT Press and UT Dallas, which is a digest of review items contextualized by newly commissioned essays on ‘burning issues’ in the art, science, technology debates. He is also a founding member of the Leonardo book series committee and advisor to *Consciousness, Literature and the Arts* (Rodopi). He is a member of the AHRC Strategic Reviewers Group and is a reviewer

and panel member for AHRC and EPSRC, the National Endowment for the Humanities, as well as for funding agencies, in USA, Canada, Portugal and the European Commission. He is also a member of the UK JHEP advisory board on cultural heritage.

His current academic functions at Plymouth are as a full-time research professor responsible for leading interdisciplinary research projects across the University with teaching responsibility for PhD supervision exclusively at Plymouth and external MSc Holistic Science dissertation supervision at Schumacher College.

Gi Taek Ryoo is Professor of English at Chungbuk National University. He received Ph.D. in English from State University of New York at Binghamton. He has published a number of articles on poetry and science, including a recent publication, 'Wallace Stevens: Chaos, Complexity, and System of Self-reference'. He is particularly interested in the parallel development of poetry and science--a comparable imaginative engagement with the world by poets and their scientific contemporaries.

Eugenia Stamboliev is a PhD Fellow in the CogNovo programme and an associated researcher at Transtechnology Research at the Plymouth University. Her background is in Media and Communication Studies, Philosophy, Law, Art History and German Literature. Her present work explores visualisation and representation of intimacy, which connects to her previous research on the illustration of hypnosis in early cinema.

Straeubig et al:

Chun-Wei Hsu is a Marie Curie PhD student in the CogNovo program at Plymouth University. Prior to her PhD, she completed a MA degree in Cognitive Neuroscience at University of Sheffield. She is currently investigating the contribution of different aspects of creative cognition to deceptive communication using neuroimaging methods (fMRI and EEG).

Pınar Öztop is a Marie Curie Fellow PhD student in CogNovo program at Plymouth University. Before starting her PhD, she completed a

MA program in Developmental Psychology at Koç University, worked as a child psychologist and also as a lecturer at Abant İzzet Baysal University. She is currently investigating group creativity and the conditions facilitating it in different age groups.

Michael Straeubig is a PhD student, game designer and creative coder, exploring games and playful experiences in various media with a focus on mixed reality and locative play. He is currently a Marie Curie Fellow in the CogNovo program at Plymouth University, researching playful systems.

Mihaela Taranu is a Marie Curie Fellow PhD student in the CogNovo program at Plymouth University. Prior to starting her PhD, she completed two masters at Babes-Bolyai University, Romania. She also worked as a trainer and volunteered in various non-governmental organizations. She is currently investigating the mechanisms and neuronal correlates of visual and auditory bistable perception.

James Sweeting is an MPhil/PhD research student at Plymouth University in the Transtechnology Research group. His focus is on videogames and their changing media form, this is explored via a focus on memory and nostalgia.