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Introduction: The Difference That Makes a Difference

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Abstract: This article introduces TripleC's Special Issue on The Difference That Makes a Difference, containing papers arising from a workshop of the same name that ran in Milton Keynes in September 2011. The background to the workshop is explained, workshop sessions are summarised, and the content of the papers introduced. Finally, some provisional outcomes from the workshop and the Special Issue are described.

Keywords: Information

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> *"For more than half a century we have known how to measure the information-conveying capacity of any given communication medium, yet we cannot give an account of how this relates to the content that this signal may or may not represent. These are serious shortcomings that impede progress in a broad range of endeavors, from the study of basic biological processes to the analysis of global economics." Terrence Deacon (2010)*

It is a cliché to say that we live in an information age, but few people would deny that the development of information technologies has had a profound impact on modern society. Information technologies are changing the way we live and work, but they are also behind a more fundamental change in the way we perceive the world - a shift from a view that places matter at the base of a hierarchy of reality, to one in which information takes centre stage (Davies and Gregersen 2010). The change is taking place to varying degrees within different academic disciplines, but is also permeating popular philosophy, with scientific materialism losing its hegemonic grip on the 'myths we live by' as information becomes more central even within the physical sciences - "Information is Physical", in the words that inspired the Oxford Physicist, Vlatko Vedral (Vedral 2010, 3).

This shift from matter to information is nicely exemplified by our changing experience of music. There was a time before recording when music couldn't be separated from people—whether singing or playing an instrument, it was a person or persons doing it. Musical scores provided instructions, but the music required people. Technology broke that tie, and music was available from an object, whether it was a musical box, pianola, a gramophone, tape or a compact disc (CD). The fact that the encoding on a CD was digital was a significant departure from analogue records and tapes, but it wasn't one that necessarily had an impact on the user. The music was tied to a physical object even if it was a digital CD instead of an analogue record. Today, however, music floats free. You can download a file and use it wherever you want, transferring between laptop and MP3 player, television and mobile phone. Or you don't even bother downloading the file, you just listen online whenever you want on your computer at the desk or via your smartphone. The music exists as information, and can flit from place to place like some disembodied spirit.

Similar discussions can be had about words, pictures, money, and many other entities. The language of information is sweeping through disciplines as diverse as sociology, economics, business and the arts. Indeed, it is difficult to identify a field that is not at least starting to describe itself in terms of information (we have addressed several of these articles in our earlier collection, Ramage and Chapman 2011).

The philosopher of information Luciano Floridi has identified the information revolution as the fourth in a series of revolutions that have displaced humankind in the universe. First there was Copernicus who displaced us from the centre of the physical universe. Then came Darwin who took away the uniqueness of the human species. Freud took away our trust in the conscious self. And now we find that we've lost the stability of our physical being, as intelligent inforgs in charge of infosphere (Floridi 2009)

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While Floridi traces the origin of the fourth revolution back to the dawn of human consciousness, it is only now that we are grappling with nature and the implications of a universe built on information. Despite the near-universal adoption of the language of information, there isn't (yet) even a satisfactory unified or unifying definition of information, and it is not clear the extent to which different disciplines mean the same thing when they use the same words. Everyone is talking about it: but are they talking about the same thing? Rafael Capurro has summarised the problem by what has come to be known as Capurro's Trilemma (Capurro et al. 1996): Information may mean the same at all levels (univocity); something similar (analogy); or something different (equivocity).

There is an urgent need to understand the relationship between the multiplicity of ways in which the language of information is used, but also, regardless of whether univocity, analogy or equivocity holds, there are important benefits to be derived from sharing insights between disciplines.

Widespread and growing recognition of this need has led to a number of events in recent years, bringing together people from different fields to explore the nature of information. An event at Leon, Spain, in 2008 (1 International Meeting of Experts in Information Theory - An Interdisciplinary Approach) led to a Special Issue of tripleC in 2009 (Diaz Nafria and Alemany 2009), and this present Special Issue arose from a workshop which took place in Milton Keynes, UK, in 2011 (The Difference that Makes a Difference: an interdisciplinary workshop on information and technology www.dtmd2011.info).

1. The Difference that Makes a Difference 2011

The title of the workshop, the difference that makes a difference, derives from Gregory Bateson's celebrated definition of information:

> *[T]here is for every molecule an infinite number of differences between its location and the locations in which it might have been. Of this infinitude, we select a very limited number, which become information. In fact, what we mean by information – the elementary unit of information – is a difference which makes a difference. (Bateson 1972)*

The workshop was specifically designed to encourage interdisciplinary conversations. Four main sessions consisted of two keynotes speakers (with the exception of the fourth session which had only one keynote, due to the illness of the second speaker) followed by four or five short, 10 minute, delegate presentations, a short rapporteur's report and then an extended period for discussions. There was then a final 'synthesis' session designed to draw together ideas from across all of the four preceding sessions. The workshop also held the first showing in the UK of Nora Bateson's film about the life of her father: "An Ecology of Mind".

The four main sessions had the themes: What is Information?; Understanding with Information; Engaging with Information; and The Impact of Information.

What is information? wrestled with philosophical and theoretical ideas of information. Some of the presentations have given rise to papers in this special issue which are discussed below (Wolfgang Hofkirchner's keynote speech on Emergent Information, presentations by Rainer Zimmermann and José Maria Díaz Nafría on the Emergence and Evolution of Meaning and by Robin Faichney on Information and Mind). In addition, keynote speaker Chris Bissell of the Open University talked about some of the lesser-known but key figures in the development of engineering communications theory (Karl Küpfmüller, Harry Nyquist, Ralph Hartley and Vladimir Kotelnikov), and presented some background to 'information' ideas in information engineering – specifically a consideration of models, and how information engineers switch between them while preserving some or all of the information. In short presentations, Paul Piwek showed how ideas of 'difference' can shed light on semantic information in natural language, and Simon D'Alfonso examined some of the philosophical categories of information, explaining the difference between, for example, semantic and environmental information.

Understanding with Information drew largely on concepts of information in the natural sciences. The keynote speakers were physicist Vlatko Vedral from Oxford University, who argued that ideas of information can be used to explain the very existence of the universe, and ecologist Jonathan Silvertown from the Open University who introduced some of the ways in which information is used in understanding and measuring biodioversity. Paolo Rocchi argued that an understanding of the semiotic concepts of signifier and signified can help understand information in the context of computing. Jeffrey Parsons, John Rosewell and Rónán Kennedy all addressed topics concerned with the non-specialist's understanding of information: Jeffrey Parsons explained how the data quality in citizen science projects can be improved by careful consideration of the information needed by participants and, in the context of one such citizen science project, iSpot; John Rosewell showed

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how a more sophisticated use of information can help with biological identification keys; while Rónán Kennedy addressed the issue of the role of information in environmental regulation. .

Engaging with Information was nominally technical, although the first keynote speaker was a sociologist, Richard Harper from Microsoft Research, who talked about performativity and the nature of content in human communication, alongside Tony Hirst from the Open University, who talked about data visualisation and the way patterns can be revealed through sophisticated graphical models of complex data sets. A key theme in this session was 'making sense of muddle' – finding ways to navigate through complex multiple information sources, often incoherent, and communicate one's understanding of that information through a variety of different media. Tyler Horan presented results of a study of the development of cultural capital on Twitter which showed how users view content as a form of symbolic capital; a medium for exchange that's surface has little to do with underlying social strategies. Christian Voigt discussed weak signals – the problem of identifying noteworthy individual events and/or wider trends that together are precursors to significant developments: distinguishing valuable weak signals from unreliable weak signals. Peter Jones discussed information in the context of health care, and presented a model, Hodges model, that is designed to support personal and group reflection, conceptualisation, to facilitate holistic and integrated care, to assist in curriculum development and to help understand and bridge the theory-practice gap. John Monk's presentation on Arrows and Ambjörn Naeve's on Cultural Evolution were expanded for papers in this Special Issue and are discussed below.

The Impact of Information had a sociological focus. The keynote speaker, Hugh Mackay, talking about Information and the Transformation of Sociology, Jan Sliwa on "Do we need a Global Brian" and Mustafa Ali on Race, all developed their presentations for Special Issue papers discussed below. Frank Land discussed "The Dark Side of Technology" arguing that while technology is neutral in value terms, entrepreneurs and innovators using the technology do not all share the values which seek to use technology to enhance the lot of mankind, and that aside from outright criminality, there are significant 'gray areas'. Robin Smith talked about the nationalisation of information risk, and proposed new approaches to managing the value of business information to incentivise the improvement of risk management to help support the economic recovery within the UK. ,

Audio recordings and copies of the slides from all presentations, together with audio recordings of the rapporteur's reports and the synthesis session, are all available with free access on the workshop website (www.dtmd2011.info). Delegates were also invited to submit full papers arising from their DTMD Presentations for consideration for this Special Issue and eight papers were accepted for publication, following anonymous reviewing.

2. Special Issue Papers

Wolfgang Hofkirchner, in *Emergent Information. When a Difference Makes a Difference…*, develops the theme of his keynote presentation to explore how Bateson's definition of information can provide the basis of a Unified Theory of Information (UTI). He argues that an integrative approach based in subject-object dialectics bridges the hard-soft, objectivist-subjectivist divide in the understanding of information. For Hofkirchner, self-organisation is at the core of information generation, and he argues that computers, though they can be part of self-organising systems, are not themselves self-organising systems and therefore cannot generate information. Finally, he argues for the need to direct technological developments towards a global sustainable information society (GSIS).

José Maria Díaz Nafría and Rainer Zimmermann in *Emergence and Evolution of Meaning*, are, like Hofkirchner, addressing the search for a Unified Theory of Information (UTI) and, with Hofkirchner, they see self-organisation as the key. They argue furthermore that 'meaning' is inextricably linked to self-organisation and to information. Self organisation, and therefore information and meaning, they argue, can found at the most fundamental level of the universe: that an understanding of information is linked to the development of a theory of everything (TOE). This perspective on information - starting from the highest level of abstraction in the fundamental physics of space-time - is a 'top down approach', and alongside it they present a 'bottom-up' approach that starts from the information available to an observer. They stress the need for both perspectives in a hermeneutic cycle.

Mind, Matter, Meaning and Information by Robin Faichney also addresses the relationship between information and meaning, but in this case in the context of minds (of humans or other animals). Faichney presents the concepts of empathy and intentionality as the basis for attributing mental processes to other organisms, and then argues that empathy and intentionality are based on intentional information, encoded by physical information.

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Ambjörn Naeve explores insights into understanding cultural transmission and development through concepts of information and communication in *Communicative Modelling of Cultural Transmission and Evolution by using Abstract Holographic Cognition*. Naeve presents a detailed and comprehensive model making use of semantically-rich diagrams, drawing upon a wide range of academic fields, including particular insights from an analogy with holograms.

For John Monk in *Arrows Can Be Dangerous*, the provision of information is just one aspect of a sign. The paper is a comprehensive investigation into the origins, development, uses and significance of signification by arrows, exploring how the image of a weapon came to be used as a sign, with a specific focus on the broad arrow, as used to represent the authority of the British government. Monk analyses the functions of arrow signs using the classification scheme of Roman Jakobson, providing insights both into the nature and function of signs and the usage of classification.

Mustafa Ali uses a reflexive hermeneutic approach in *Race: the Difference That Makes a Difference* to bring together critical information theory with critical race theory and throw light on each. He takes ideas from information theory to derive insights into race and racism - such as relating the question of whether information requires an informee to whether racism has to be consciously affirmed - and vice versa.

Jan Sliwa in *Do we need a Global Brain* explores the consequences of a future in which it is possible to 'gather every available information about everything and everyone'. He raises concerns about the risks from totalitarian government and criminals, but draws particular attention to the issues that could arise even under a benign authority. Starting with obvious benefits that can come from information such as in health monitoring, he raises the questions of interpretation and use of information, of authority and how, and by whom, decisions are made. He uncovers difficult and troubling issues.

Hugh Mackay argues in *Information and the Transformation of Sociology* that the scale and form of information today challenges some of sociology's core methods and practice. He explains how, in the first place, information has become an object of study for sociologists, especially in the form of accounts of the shift to an 'Information Society'. Secondly, he argues, sociology is being transformed by the growth of huge volumes of commercial transactional information with the result that social data is no longer the preserve of sociologists.

3. Outcomes

The aim of the DTMD 2011 was expressed as follows:

> *This workshop seeks to bring together those working with information in a wide range of disciplines - engineers and technologists together with scientists, philosophers, social scientists and artists - to discuss and expand our collective understanding of what we mean by information in our different disciplines. We are not seeking to combine these different understandings, but to share them and to explore commonalities.*

A future paper analysing the insights of The Difference That Makes Difference 2011 is planned by the organisers, but a few provisional observations on commonalities in the papers of this Special Issue follow here.

Several of the contributors (Naeve, Hofkirchner, Díaz Nafría and Zimmermann, and Ali) specifically use Bateson's definition of information as the 'difference which make a difference', and one observation is about the utility of the formulation. It succeeds as a starting point for a definition of information in many fields, and it provokes insights by drawing attention to differences – both the making differences and the made differences (difference as subject and as object).

'Meaning' (semantics) is a common concern, as a primary focus of two of the papers (Díaz Nafría and Zimmermann, and Faichney); identified explicitly as an aspect of information in some (Ali and Naeve); used as part of the language of information in others (Hofkirchner and Monk); and implicitly important in the remaining papers (Sliwa and Mackay).

'Intentionality' similarly appears as a key concern of some papers (Naeve and Faichney), is explicitly considered in some (Hofkirchner, and Díaz Nafría and Zimmermann) and is part of the discussion in others (Ali and Monk).

Questions of truth, falsehood and errors appear in some papers (especially Díaz Nafría and Zimmermann, Naeve, and Sliwa), and, for these authors, false information and errors are important aspects of the development of information – not something to be dismissed as 'no information'.

Several of the authors talk about why it is important to understand subjects in terms of information (especially Ali, Hofkirchner, and Díaz Nafría and Zimmermann) and about how our lives and

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communities are changing with developments in computing and information technologies (especially Hofkircher, Sliwa and Mackay).

A couple of papers (Hofkirchner and Sliwa), expressly appeal for people to take control of information technologies for the good of humankind, but, for all the authors, understanding information, what it is, and/or how to handle it, are issues of the highest priority, intimately linked to the most pressing concerns facing the world.

This brings us back to the original motivation for the workshop, and, indeed, for the follow-on workshop DTMD 2013 which will be held in Milton Keynes April 8th-10th 2013. Understanding information matters, and it will only be possible through interdisciplinary discussion.

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