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Realising Virtual Reality:
A Reflection on the Continuing Evolution of New Media

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ABSTRACT

This paper addresses the continuing convergence and integration of digital electronic media, and in particular, virtual reality as an exemplar phenomenal media. The author explores and further develops the theme that each of such media entails a specific lexicon or language of use that continually evolves. For this media to be effective, however, it must be widely understood within its community of practice. In this paper, virtual reality is discussed as an exemplar new-media application as a means of virtual representation or reflection of events or behaviours in the real world from a socio-technical perspective.

Keywords: *Communication, Convergence, Media Language, New-Media, Perception, Synthetic Worlds, Visualization*

The continuing development and Moore's Law style growth in micro-electronics and related digital technologies, has inexorably led to the development of specialised human-machine interface systems necessary for the integrated use of such technologies. It is largely this integration of underlying technology and interface systems with continually changing modes of use and user expectations that drives the continuing evolution of contemporary new-media. In turn, the continuing introduction of new new-media based applications continues to influence and in effect transform the way we communicate, work, make decisions, rest and play.

Given the endemic presence of media hype, marketing disinformation and occasional more outrageous predictions of over-excited techno-evangelists in the area of new technology and its application, it is sobering to reflect on Thomas Edison's observation, circa 1913: *It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years* (Attributed to Edison (1913) in Gould & Mason, 1985, p. 1.) Clearly, with the advantage of hindsight, a prediction about the role of motion film which failed to appreciate both the real potential and the limitations of film media.

Contemporary new-media is substantively based on the integration of multiple digital electronics and computer technologies. As such, it reflects a continuing convergence of what was previously considered disparate media with discontinuous applications. To a large extent this is no longer the case, as technologies and applications seemingly converge, or at least utilize common components and exhibit com-

mon characteristics and interdependencies. In turn, this raises many questions of process and practice in the use of such still evolving 'new media'. For example, Manovich (2001) referred to such convergence as a computer media revolution that is affecting all stages of contemporary communication and impacting on all types of communication media, whether text, images, sound, or graphics construction based. *How shall we begin to map out the effects of this fundamental shift?* (Manovich, 2001, p. 19-20) He subsequently developed his argument along the lines of cultural transcoding of new and meta-media. A form of differential aesthetic wherein both media and the multiple and often divergent social and organizational cultural contexts in which it operates and is operated on, are in a constant state of change and interaction (Manovich, 2001; Murphie & Potts, 2003; Charles, 2009). In the context of considering organizational culture as a system of shared meaning within a given organization (Robbins & Barnwell, 2006) the implication is that the parameters that influence and affect the collected/shared meanings, beliefs, assumptions, behaviours and practices within a contemporary organization, are subject not only to internal shared pressures and adjustments, but also are affected by the (initially) external influences for innovation and change resulting from perceived opportunities and threats associated with new inbound technology, such as in this case, new-media.

In effect, the traditional business construct of a value chain for contemporary new media hinges on new media's capacity to represent and add value to information in a form capable of translation, transformation, and distribution wherever and whenever digital processes and electronic network communication is accessible. Today, this implies virtually any time, anywhere on the globe (Lister et al., 2009). In large measure then, the technological aspects of new media can be seen as a continually evolving new form and set of technological artifacts, as a consequence of continuing and widespread digitalization and presumed technological convergence of networkable media and systems. Castells describes this mass diffusion of information and communications technology as being the key element in formulating a new social structure or 'networked society' (Castells, 1996). He further outlined a 'new economy' based on information and communications technology and exhibiting the three core characteristics of 'informational', 'global', and 'networked' (Castells (2000) cited in Flew, 2005). In a sociological sense this can be interpreted in the case of new-media as a continuing growth in connectivity between: purpose (for the introduction of new-media); functionality (of new-media as an effective communicative medium); role (of new-media within a given communication context); place (both at a geographical level and 'logical' positioning within a given community of practice); relationships to contemporary cultural norms (whether within or between organizational contexts or at a broader societal context); and its potency (ostensibly resulting from both technology-technology and business-technology convergence (Andriole, 2005)) as an inherently transformative media. As such, it is essential that we explore the nature of such potentially transformative media and determine just how, when and where we may utilize to best advantage its strengths whilst mitigating potential demerits (Woolgar, 2002).

However, the very notion of convergence is now itself a source of argument and rethinking, from Manovich's 'cultural transcoding' (Manovich, 2001) to Jenkins' 'convergence culture' (Jenkins, 2006), Storsul and Stuedahl's 'ambivalence towards convergence' (Storsul & Stuedahl, 2007), and Knight and Weedon's 'shifting notions of convergence' (Knight & Weedon, 2009). The complexity and changing face of which, with regard to new-media and virtual reality (VR) related media in particular, is further compounded by the non-elemental character of new-media as a thriving hybrid of multiple (largely digital) technologies, sociological constructs (contexts, relationships, communicative behaviours and cultural norms) and (at least from a constructivist viewpoint) with an inherent capability to influence cognitive perceptions and related behaviours within

or external to synthetic or virtual-world environments (Coyne, 1995). It is this *decoupling of space from place* (Shields, 2003, p. 42) to create virtual representations and constructions of real or imagined objects/subjects/environments and associated relationships, which most notably distinguish new-media VR applications from earlier communication media. Whilst new-media in its various forms, may be the current ontological unit of technological development resulting from intense digital technology convergence, its use to deploy conceptual virtual reality (the term in itself a classic oxymoron) as a working 'space' in which the media activates its users (or at least appears to, in a technologically deterministic sense) to scale the virtual mountains of innovation (or whatever virtual form or referent the virtual environment may take) reflects further McLuhan's much earlier observation about the context of new evolving media, that: *Today the environment itself becomes the artifact* (McLuhan (1964) cited in Heim, 1993, p. 66).

The actual term 'virtual reality' first appears in 1986 and is attributed to Jaron Lanier (early VR entrepreneur and founder of the ill-fated VR development company 'VPL Research') (Heim, 1998). Progressively, commercial VR products entered the marketplace. By year 2000, VR systems were available globally and had penetrated virtually all areas of industrial design, computer gaming/entertainment, defence strategy development and training, real-time military battlespace planning and management, medical research and training, nuclear research, and a growing array of real-time control systems and robotics. There would appear to be almost as many definitions of virtual reality as there are interested users of the technology and its associated systems. Each such user in turn bringing his or her own perceptions, interests and ownerships, to bear on their particular use and application of VR. These vary from the simplistic and pragmatic to the highly sophisticated and abstract. A wide array of integrated new-media technologies can be utilised to form virtual reality systems. These can vary from simple desk-top computers with broadband communications access to the internet enabling interactive applications such as Second Life to run on the office desk-top, through to highly sophisticated supercomputer-based systems supporting multiple overhead image projection onto surrounding screens with multi-directional surround sound, or semi-enclosed multi-wall projection environments called CAVEs used with stereo-vision shutter glasses and hand-held haptic control devices to provide interactive full surround/immersive three-dimensional imaging, or even hand-held 'touch' screen devices incorporating WiFi connection to either internet or local intranet applications.

The actual underlying technology bases of electronic and digital media have undergone constant, if at times rather erratic or spectacular, innovation and change and technological convergence. So also the communities of practice, the users of such technological innovation, have undergone continuing social and organizational cultural change with at times dramatic discontinuities. For example: the dot-com boom and bust of the late 1990s and early 2000s; the transition from analog to digital radio and television with its significant impact on user expectations of image and audio quality; the introduction of miniature MPEG players or iPods supporting 1000s of high fidelity quality audio files, videos and movies downloadable from the internet via secure broadband WiFi networks; and the introduction of high resolution computer graphics enabling special visual effects in video and movies integrated with and largely indistinguishable from actual photographic images.

Just as earlier analog or time dependent media have progressively converged with digital media to acquire a new form and extended functionality, so also did they acquire a new language that addresses concomitant changes and challenges in the field of mass-communication and associated user community cultural norms. For example, earlier communication media such as broadcast medium-wave radio was essentially constrained by geographic distribution and reception 'reach' and largely compliant with community based, or regionally specific

interests and accepted patterns of behaviour, although the opportunity to institute focused information dissemination or 'propaganda' mode broadcasts was certainly not lost on some community groups (Shultze, 1988). Eventually, the introduction of short-wave radio bands, higher transmission power, increased receiver performance and low user entry costs, extended this reach well beyond local and even regional areas. By comparison, the new-media based communication technologies of today, such as the internet and world-wide-web, are virtually unconstrained by geographic reach (Lister et al., 2009) and certainly not by local or even regional cultural norms (despite attempts by some government's agencies to censor or constrain their populace's access to some content). They also reflect, in common with earlier electronic media, typical characteristics of successful innovation diffusion, including: demonstrably improved performance over alternative media in a key area or multiple key areas of interest (for example, including but not limited to: global mass communications, speed of delivery, widespread access, potential for secure asynchronous and synchronous communication and interaction) with decreasing unit costs, multiple (competitive/non-monopolistic) providers of required technology and services, and increasing reliability, collectively resulting in widespread acceptance (Rogers, 2003). Such changes have also seen continuing departures from traditional forms of communication media use, as in the expanding use of online immersive virtual-world environments such as Second Life and the wide variety of semi-immersive virtual-world gaming systems (Boellstorff, 2008; Jenkins, 2006; Kreps, 2008; Manovich, 2001).

Increasingly, users of various forms of new media are being faced with frequent innovation and change in base technology, interface mechanisms and role and function of new media. Adjusting to such shifts and changes is increasingly not just a case of adapting to new base-technology or modified processes. Rather, developers and users alike are finding, exploring and indeed creating fundamental adaptations to role and function and congruent extension to the nature and characteristics of a given form of media and its potential influence and impact on its associated community of practice. Within and adapting in accord with these changes, the very 'language' and structure of new media is also evolving with time. A language that is being formed and reformed, both by convergent technologies and the convergence of similar, yet differing, communities of practice with in turn, changing needs and expectations and continuing adaptations in perceptions of social reality and context, behaviours and cultural norms (Flew, 2005).

In a similar vein of argument, Richard Caldine of the Centre for Staff Development at the University of Wollongong (circa 1994) extended many of his observations on imaging techniques and message structuring in educational television to the then growing areas of commonality between the then new media: Internet and early multi-media based systems. *An understanding of the language of television will assist those who in the future are faced with other screen-based media as the language of television forms the basis of the lexicon for multimedia* (Caldine, 1994, p. 3). This insight into the concept of a need to understand, or at least appreciate, the language of a particular media and their associated communities of practice, is of particular relevance, although many (including the author) would certainly challenge the inherent implications of attempting to use television as having an implicitly transferable media language.

One of the earliest documented evidences of the existence of such 'media language' dates to the broadcast on October 30th 1938 of a live-to-air radio play: H. G. Welles' War of the Worlds. Its graphic descriptions of an alien invasion produced wide-spread panic and mass hysteria. Listeners had taken the broadcast as reporting on an actual live event. It was, but it was a radio drama event. In 1938, most radio producers and listeners were yet to develop an understanding of the power and presence of radio media as a challenging and potentially gritty new aural art-form. Radio broadcasting was seen as a low-cost mass-communications me-

dia capable of distributing music, news, sports commentary, advertisements, and dissemination of information on issues of political and community interest through talks, interviews and religious programming (Gosling, 2004; Miller, 2000; Slouka, 1995). The advantages of being able to extend reach to large numbers of the populace distributed over vast areas, in real-time, at a time of one's choosing (at least for station owners, producers of programming and/or for those willing and able to pay for a favoured time-window) being a core driving influence on the acceptance and growth of broadcast radio media. This is highlighted for example in the wide-spread use of radio broadcasting for dissemination of evangelical Christian religious programming from the earliest years of radio media in the USA (Schultze, 1988). This rapid uptake of a new media appears to have been largely driven by the simple principle of accessing the ever widening 'reach' and immediacy of radio broadcast media compared to the almost architectural limitations of the church pulpit, whilst retaining the rhetorical influence, impact and sense of immediacy in the mode of delivery. Here can be seen some of the earliest signs of ascendancy in the core-characteristics of: immediacy, presence and reach, in contemporary electronic media.

The introduction of public television in the late 1930's and early 1940's pushed the levels of power and presence of broadcast communications media even further, extending the language lexicon. During the same period lavish productions in colour movie film media began to expand globally, again exhibiting a further variation to media language, function, and status within society (Jenkins, 2006). Sixty years later, with the continuing growth in communications media and associated supporting technologies, has come a concomitant development in electronic media complexity, capability, applications, reach and pervasiveness, to the point of ubiquitousness. With this has also come a growth in perceptions of the language and functionalities of such media, although some would argue not necessarily in understandings.

Expanded functionalities in 'user' telecommunications media over the past two decades provide a particularly glaring example of media convergence and the potential for media language conflict: the fixed/wired telephone versus the mobile telephone with built in digital camera; iPod portable media player with Wi-Fi text messaging/email and internet access; mobile Global Positioning System (GPS) with built-in maps, location finding and travel directions. Each device with its own specific enhancements to communications, yet each also carrying inherent constraints and restrictions and collectively representing further convergence in both the telecommunications and information technology bases, and the characteristics of contemporary media and their associated communities of practice (Bell, 2007; Jenkins, 2006; Sobel Lojeski & Reilly, 2008).

Marshal McLuhan, creator of the aphoristic expressions: *the medium is the message* (McLuhan, 1964, p. 7); *radio: the tribal drum* (McLuhan, 1964, p. 297); and *the global village* (McLuhan & Fiore, 1968, title) was particularly concerned about electronic media, its impact on society and our understandings of communication. He categorized communication media as being either 'hot' or 'cold' based on the intensity of information involved, engagement of the user, and the required commitment and participation of the user, especially as this relates to the use of multiple senses (sensory perception) in order to effectively interpret message content (Flew, 2005; McLuhan, 1964).

McLuhan ascribes the status of 'hot' to photographic media, as photographic imaging is generally visually of high definition and as such well filled with data. The telephone and general auditory speech he describes as being 'cool' media because *so little is given and so much has to be filled in by the listener* (McLuhan, 1964, p. 22).

McLuhan's definition, established some 20 years prior to the introduction of multi-media and 30 years prior to the first effective large scale commercial virtual reality systems and technology (SGI Virtual Reality Center circa 1994) and the age of digital convergence (Yof-

fie, 1997) proves problematic when applied to virtual reality media. It would appear to classify virtual reality (VR) media as both hot and cool, depending on the design focus of the application:

- High in participation and immersive engagement by the user = cool
- High definition as in: *well filled with data* (McLuhan, 1964, p. 22) and extends (multiple) senses in high definition = hot).

Here can be seen the complexity of VR media and new media in general, with its capacity for concurrent intensive exposure to both high definition data and high level interaction through the immersive experience of tele-presence, exemplifying McLuhan's hot and cool media parameters in a unique form of duality.

McLuhan also proposed a tetrad of four laws or effects of media. These in turn highlight the complexities of endeavouring to uncover and understand the meanings and language of specific 'media'. He posed four questions to be asked of any medium: *What does it enhance or amplify in the culture? What does it obsolesce or push out of prominence? What does it retrieve from the past, from the previously obsolesced?* And here the tetrad projects into the future – *What does the medium reverse or flip into when it reaches the limits of its potential?* (McLuhan and McLuhan (1988) as cited in Levinson, 2001, p. 16).

For McLuhan, radio was an example of an enhancement to communications that extended oral forms of communication. In the terms of McLuhan's tetrad it enhanced or amplified oral communications. Similarly, it obsolesced the newspaper as a significant medium for written communication, retrieved something of the earlier prominence of oral communication, but with the further passage of time it in effect reversed into the medium of television with its more graphic use of combined sound and moving images (McLuhan and McLuhan (1988) as cited in Levinson, 2001, p. 16; Sui & Goodchild, 2003).

The following provides a further extrapolation of McLuhan's tetrad as applied to contemporary virtual reality media as an exemplar new media:

- ➢ Virtual reality amplifies sensory perception through stimulating the use of multiple senses (visual, auditory, tactile, and associated enhanced cognition factors)
- ➢ It obsolesces 2D and constrained 3D graphics-image based simulation by providing opportunity to access a whole-of-world view (the Weltanschauung of systems thinking) through creation of multiple systems of systems in synthetic environments, or virtual worlds.
- ➢ It retrieves the artisan hands-on experiential mode of exploratory learning and skills development whilst reducing inherent risk and enhancing potential quality of outcomes.
- ➢ It reverses (potentially) into a closer understanding of the reality of the world around us and prepares the way for even more sophisticated visual media capable of providing connectivity for manipulating real world entities from within virtual world environments.

It is perhaps in this fourth characteristic that we see the most dramatic indicators of the future strategic potentialities for virtual reality technology and systems. However, the first three are clearly all implicit in contemporary virtual reality systems. Strategic positioning of such new media in contemporary organizations may well be seen as focusing on optimising the effects of these three characteristics.

In the first instance, amplifying sensory perception, there is widespread acceptance that the multi-sensory nature of new-media, particularly those capable of creating conditions of user immersion, does provide enhancement in perception and potentially in performance, although it is still difficult to find actual measures of the latter (Friedhoff & Peercy, 2000; Lister et al., 2009; Stair & Reynolds, 2006; Turban et al., 2002). Such measures should not be confused, as they often are, with measures of system performance, where virtual reality simulations can

achieve design and testing results faster than traditional techniques (Stair & Reynolds, 2006). Whilst virtual reality new-media systems may well utilize multiple sensory stimulation, it is primarily the use of visualization that epitomizes virtual reality tools. Historically, engineers have been long-time users of visualization tools and strategies, from pen and parchment, to pointing device and computer screen. All have played critical roles in the evolution of contemporary visualization aids as a means for developing virtual models of proposed and/or real-world structures. *Information visualization... was inspired by the idea of applying scientific visualization techniques to abstract information spaces. Information visualization focuses on the use of interactive techniques that can transform data, information, and knowledge into a form from which the human visual system can easily perceive its meaning* (Attributed to Robertson et al. (1993) in Chen, 2006, p. 156).

The impact on designers and project stakeholders alike of visualizing how a final product or structure might appear in the real world invokes a complex interaction of the perceptual, affective and cognitive domains of intellectual behaviour (Jones, 1996). *A good visualization is something that allows us to drill down and find more data about anything that seems important... in reality we are just as likely to see an interesting detail, zoom out to get an overview, find some related information in a lateral segue, and then zoom in again to get the details of the original object of interest* (Ware, 2004, p. 317). The use of immersive visualization may then further amplify sensory (albeit primarily visual) perception through direct engagement with virtual world objects and their affective relationships. In the context of using virtual worlds to support decision-making, a virtual world may or may not provide a direct visual correspondence with the real world. Rather, it must provide virtual representations of those parameters or characteristics that in the real world have or result in real and identifiable effects (Hunsinger, 2008). The actual construction of the virtual world may involve the use of shapes, colour, position, mobility, and other controllable or attributable characteristics. The core purpose being, to enable visualization of information, conditions, status, variables, in such a way that managers can effectively perceive, extract and interpret meaning from data so represented (Chen, 2006).

An example of the second characteristic, obsolescence, can be seen in a major project involving the progressive conversion of existing CAD graphics, used by some 200 parts and components suppliers for a large industrial manufacturer, to fully defined 3D objects importable into geographically distributed (global on-line) virtual reality environments. In time, even subtle design changes within the virtual world version of the product will result in virtual adjustments to the multiple component parts affected by the proposed change. Duly exported back to the suppliers, these adjustments may then result in appropriate re-engineering/design, re-tooling, and subsequent supply of new components much faster and potentially cheaper, than current techniques and procedures. This example of both the introduction of 3D visualization based new-media and the interaction between complex systems of systems, also demonstrates the continuing evolution and application of contemporary systems thinking as an holistic approach to the development of new ideas and their implementation. In this case, the introduction of a geographically distributed 3D virtual reality environment providing an effective alternative approach to the use of traditional 2D based visualization design tools, through introducing and integrating, in a systems context, contemporary new-media based tools for problem definition and resolution in an area of considerable design complexity (Maani & Cavana, 2000).

The third characteristic, retrieval, is more subtle in nature. In management terms, it is akin to the classic concept of 'management by walking around', enabling the manager to see, hear, feel what is actually happening in the organization in real-time. Its potential connectivity to Quality Management approaches is also particularly relevant. Another factor that potentially illustrates this third characteristic

is the growing acknowledgement of Knowledge Management as a 21st century motif for implementing effective executive decision support systems (Blecker, 2005). To be able to more effectively access the intellectual capital and corporate memory of the organization is a serious strategic challenge for many organizations. Connectivity between an organization's collective data and information collection and storage systems and a new media visualization tool such as VR, may well be a significant means of creating strategic advantage, through leveraging off the organization's unique knowledge, competence and skills base as strategic capabilities (Johnson et al., 2008). It is this very notion of connectivity that new forms of communications media very often address. Virtual reality research in particular, has facilitated new ways of thinking about the way we communicate complex messages and information, with a particular focus on the evolution of new (virtual) social structures that in turn facilitate acquisition of collective knowledge and shared meaning across both established and new communities of practice (Papargyris & Poulymenakou, 2008; Woolgar, 2002).

Using sophisticated visualization strategies such as virtual reality and associated technologies, to facilitate comprehension, understanding, and extract meaning embodied in the process of looking back at what was, reviewing the present for what is, and developing simulation and synthesis strategies to prepare for what might be, demands new approaches, new skills and new insights. These will certainly be among the key challenges facing company management, Quality systems professionals, production management staff and design technologists alike, in these early years of the 21st century (McLay, 2002). This focus on considering the impact of new-media on society through observing and evaluating its influence on and effective replacement of incumbent or old media, is strongly reflected in McLuhan's view that we may best understand a new media by using it in effect as a *rear-view-mirror* (McLuhan and Fiore (1968) as cited in Levinson, 2001, p. 173) at the very least during the transition era from the old to the new and progressively as it evolves, enhances and in turn is subsequently obsolesced and displaced (Jones, 2003; Theall, 1971).

McLuhan's idiomatic approach and aphoristic language may be difficult to follow with its implicit technological determinism style focus on media as a primary causal influence on society and contemporary culture. However, his insights into the place and role of electronic media in society is still of considerable significance when looking to the new-media of the 21st century, 40 years after McLuhan first published 'Understanding Media: The Extensions of Man' and enigmatically titled the first chapter: 'The Medium is the Message' (Levinson, 2001; McLuhan, 1964; Murphie & Potts, 2003).

The above analysis is of particular relevance to thinking about evolving technologies and new-media such as VR and the extent to which they influence or affect our lives and work environments (whether directly or indirectly) and our responses to and understandings of such media and its potential to 'add value' or enhance performance, or even simply to replace an outmoded mechanism. *For McLuhan, the 'grammar' of a medium structures human sensory responses to it, fundamentally altering perceptions of social reality* (Flew, 2005, p. 32). A key to the grammar of a media is an understanding of the structure and the manner of communication it supports. From earliest times the dominant forms of human communication have been synchronous, that is in real-time, at a defined point in time and between concomitant participants, as illustrated in oral communication and touch. The progressive development of alternative means of communication such as drawing, the written word, introduction of the printing press and eventually the development of electronic media, introduced asynchronous or time-displaced communication. The capacity to record and transport communications over space and time, both synchronous and asynchronous as with telephony, radio, television, the Internet and World-Wide-Web, has added further complexity to the grammar, and by now multiple languages, uses, influences

and impacts, of communication media. *With new-media, time does not necessarily adhere to the seemingly 'linear' constraints of either face-to-face conversation or early media... With electronic media, the boundaries of synchronous and asynchronous communication are being stretched and merged in new ways* (Jones, 2003, pp. 429-430); A form of incipient stretching of time, space and place in the introduction of new approaches to communication.

Similarly, new media such as virtual reality require an understanding of the media's particular capabilities, constraints and potentially transformative impacts on both its community of practice and surrounding social culture. This in turn is largely influenced through understandings of, and growing literacy in, the language of the media. *Like any media, the use or "reading" of VR has to be learned... That is, the user becomes literate with the medium... As a new medium, the "language" of VR is still in its infancy* (Sherman & Craig, 1995, p. 37). Curiously, although more than a decade later, this reference to infancy appears to still be the case, with some possible exceptions in some areas of immersive interactive VR computer gaming and the more recent development of online VR applications such as Second Life (Boellstorff, 2008; Kreps, 2008).

Soren Kolstrup, a media researcher with an interest in visual communications, has grappled with formulating understandings of the language of visual media (and in the context of this paper, new media such as VR) with an emphasis on the use of visual communications as being about: *Communicative pictures: the production of visual meaning, the transmission of visual meaning and the reception of visual meaning* (Kolstrup, 2003, p. 77). In order to perceive and understand such meanings in visual communications, Kolstrup (2003) argues for the development and application of an interactive visual grammar. The construction of such a grammar would then need to address fundamental issues such as the basis for constructing images and the subsequent basis for being able to understand and interpret meaning from such images. He proposed that such a grammar of visual language should address: theoretical and practical perspectives on all aspects of the construction of images; perspectives on the relationships between construction (of images) and their implied or intended meaning; and *insight into the fact that with a restricted number of elemental principles you can create a huge number of pictures...; insight into the ways picture construction and social use of the pictures are related, that is, the picture as part of a narrative, and argumentation, etc* (Kolstrup, 2003, p. 78).

Kolstup's grammar of visual language, and in particular his insightful reference to its use in relation to developing visualization as narrative and argumentation, is of particular interest and may well prove a powerful tool in developing a successful role for complex imagery (such as in 3-D virtual reality) in a broadened range of future applications outside of the film, television and print media. In the context of using new-media as a visualization tool, such a grammar may prove a necessity to enable widespread diffusion, use and effective extraction of meaning from complex three-dimensional images as representations of data. Current two-dimensional image constructions for such would include the ubiquitous bar-graph, pie-chart and vector diagram. Future applications and associated sociotechnical analyses for which complex multi-dimensional imagery may prove beneficial could include: identifying multi-dimensional contextual influences on an object or subject of enquiry; or futurist projections of a complex of influences or sensitivities affecting a community of practice. The use of 'image' as both representation of influencing factors and as an analysis tool to aid in the extraction and representation of 'meaning' through complex multi-dimensional visual communication, will in turn require a community of practice skilled in the use of such language and grammar (Kolstup, 2003). An example of diffusion of an earlier informal version of a visual 'grammar' through a community of practice can be seen in the rapid evolution and diffusion of computer-gaming techniques, typically requiring rapid cognition processing and

eye-hand coordination based on recognition of visual cues connected in turn to interpretation of cues implicit in the 'story-line' and constructed grammar of the game.

The role of language in the evolution of human culture has long been acknowledged, although the extrapolation to considering the language of communication media and its impact on culture has been less well understood. *Language in its widest sense... is the medium in which culture exists and through which it is transmitted...* (Dewey (1938) as cited in Betz, 2003, p. 413). By further extrapolation, the presence, role and use of new media is a growing reality in a world increasingly structured around the acquisition and distribution (usually through the medium of digital media) of information, its analysis, subsequent interpretation and communication of meanings to interested parties. Ken Pimental and Kevin Teixeira, early researchers in VR systems at Intel, argued at length for the use of VR in communicating ideas: *VR is more than a computer technology that places the user inside a 3-D world; it's the artificial world itself... a new kind of experience... a method of communicating ideas... VR might not only change the way we communicate, it might also change the way we think* (Pimental & Teixeira, 1993, pp. xv, p. 17). It is this potential for using new-media VR systems to help develop new ways of expressing and communicating complex and abstract ideas, that has attracted the attention of contemporary educators, strategic thinkers, and cognitive scientists alike (Boellstorff, 2008).

Certainly, the notion that the constructs of human language as a communications medium limits the possibilities of thought processes has long been an issue addressed by philosophers, linguists and anthropologists alike. As Mary Douglas then Professor of Social Anthropology at University College, London, explains so succinctly: *Language is not an independent variable, nor is thought controlled and formed by it. For both speech and thought are dependent parts of human communication. The control is not in the speech form but in the set of human relations which generate thought and speech* (Douglas, 1975, p. 176). It is this very notion of exploring relationships and ideas that new forms of communications media can help address. New-media and the use of virtual-world constructs (whether on-line or within closed environments such as virtual reality centres, CAVEs or desktop workstation systems) has opened new ways of thinking about the way we communicate complex messages and information, with a particular focus on the evolution of new (virtual) social structures (such as on-line communities) that in turn facilitate acquisition of collective knowledge and shared meaning across new communities of practice (Boellstorff, 2008; Papargyris & Poulymenakou, 2008).

The essential VR constructs of highly visual and multi-sensory stimulatory media presents strong attractions to educational researchers. New methods of representation of ideas and concepts are evolving along with concomitant restructuring of epistemological and ontological constructs of what it means to know or experience knowing in a virtual or synthetic world experience. This raises questions about the capacity of the user to perceive, let alone understand and duly interpret, meaning embedded in complex images and virtual environments (Desouza & Hensgen, 2004). In developing sophisticated imaging systems and technologies, we need to be cognizant of the inherent complexity of our visual perception processes and various mechanisms and constraints that impact on the user's ability to process visual information and extract meaning. Visual perception involves integrating elements of an image to establish meaning, whilst at the same time segregating and differentiating objects within our field of vision, separating them from their backgrounds to similarly extract meaning from their images (Danesi, 2002; Friedhoff & Peercy, 2000). A variety of cognition factors then affect our capacity to process and extract meaning from the images of the world that surrounds us. Applying our understanding of these factors to the mechanisms of immersive media can enable us to better understand and use the key parameters that can in turn enable effective perception and interpretation of implied (or

otherwise) meaning in a simulated or virtual environment and to extrapolate or adapt such meanings, where relevant, to our understandings of the real world. *Reasoning determines what the mind does with sensory inputs, or perception. Mind assembles sensory data into conceptions, representations of objects – pictures, images, representations, ideas of things existing outside the mind, outside the self – external in the real world...* (Betz, 2003, p. 403). Whilst Betz was seeking to explore and explain something of the mind's capacity to comprehend and make rational determinations about the world around us, his subsequent imputation and use of Kantian styled argument implies a form of *a priori* reasoning in our comprehension and interpretation of images and sensory stimulation from our surrounding world (Papineau, 2004). Nothing could be further from the truth when dealing with rampant virtuality in some immersive synthetic world environments where nothing is necessarily what it seems and may well have no actual referent in the real world! (Hunsinger, 2008).

However, allowing that Betz (2003) was primarily concerned about elaborating on the mind's processes in constructing and interpreting images and sensory input from the real world, in turn, the connection to the way we relate to imaging and sensory stimulation in virtual worlds, and immersive visual media in particular, is all too apparent. Kantian or not, our real-world experience is the predicate for being able to comprehend and make sense of new images and forms, whether in terms of shape, colour, time-variance, or spatiality in a virtual world. In virtual reality environments these sensory parameters are primarily visual in nature, that is, sight remains the dominant stimulus, although certainly not the only one, even in a synthetic environment. Whilst visual immersion parameters may well be the most obvious, there are other factors that impact on our ability/capacity to perceive and relate to virtual objects, subject matter, or contextual relationships in synthetic environments. An example of how such factors are being identified and addressed can be seen in such projects as the development of a virtual reality-style Haptic Nanomanipulator as a means of touching and manipulating objects and particles too small, elusive, or time-dependent, to be observed or communicated within the normal or real world. This raises a range of issues in relation to the operator's ability to: *Communicate, perceive, act on, and understand inaccessible worlds: located too far away (e.g., a planet) dangerous (e.g., a toxic area) too large (e.g., a galaxy) too small (e.g., a nano-object) or evidently non-real (e.g. mathematical figures, numerical data, and computer fictitious worlds)* (Luciani, 2002).

There is also a further aspect to perception that goes beyond the above largely physiological exposition: the use of images and synthetic environments as representational mechanisms that provide insight and/or the means of exploration of ideas. In effect, a means of invoking a new way of thinking, whether about the old, the new, and the unknown (or at best, areas or issues with a high level of uncertainty). This implies taking new-media imaging and user sense stimulation to a new level of process. For example, as a means of exploring 'possibilities', searching for hidden associations or similarities between unlike parameters, explorations in design where new concepts can be created as imagined rather than as could not be constructed or easily realized in the real world. As such, a new means of communicating ideas, the explicit use of communications media as 'thinking tools'. Many authors have referred to new media in its various and convergent forms as being potentially new thinking tools, albeit with their own form of media language and potentially unique representational structures and symbolisms, participatory culture, and as a form of communication through which new culture or cultural variance is constructed (Boellstorff, 2008; Flew, 2005; Pimental & Teixeira, 1993; Manovich, 2001). The evolution of VR as a means of implementing graphic illusion, of tele-presence, simulated experience in synthetic worlds, and virtual realism genuinely capable of fooling the senses, has meant a focus on critical aspects of simulated experience such as: immersion; interactivity; and a necessary leap of

imagination! Indeed, in the light of the potentials of virtual world building, it appears there is an inherent risk that 17th Century philosopher Descartes' fundamental proposition *"Cogito ergo sum"* (I think therefore I am) (Descartes, 1642) may well be re-written by contemporary virtual world builders as being *'Cogito ergo virtualis'* (I think therefore I might be!).

These mind exercises provide us with both insights and challenges when developing new models of conceptualization and thinking practices. The very concept of using synthetic or virtual worlds, and virtual objects, constructs and models, and manipulating and using them as thinking tools (as distinct from use as highly structured and technologically focused design and development tools) potentially raises serious challenges for non technology-oriented future users, such as decision makers accustomed to working with established thinking, reporting, analysis processes, and rational decision-making practice premised on empirical observation and measurement, most likely in a commercially-oriented sense. *The bifurcation of nature between mind and matter, observer and observed, subject and object. It has become built into the whole of Western man's way of looking at things, including the whole of our science* (Williams and Magee (1999, Ch. 27) in Warburton, 1999, p. 254).

There has been much argument over the past 350 years since Descartes on possible relationships between observed and observer, the known and the knower, the material and non-material, and what it is to 'know' in an epistemological sense. In turn, modern philosophy has moved on to challenge these earlier viewpoints and to raise new positions. Yet, fundamental to the possibility of using such a technology (or set of technologies) as new-media VR, are these underlying questions and viewpoints dealing with the epistemological and ontological issues of enquiry relative to what is 'known' and the nature of 'being' (Cohen, 2000; Papineau, 2004). And, in the context of using virtual reality tools and systems, the possible positions of these questions and viewpoints within the construct of deliberately and with intent using illusion to: explore, express and communicate new ideas; construct virtual 'aesthetic' objects (Manovich, 2001) and relationships (possibly at times with no attributable or actual referent in the 'real' world); create, or at least induce, new communities of practice and engagement (as per Second Life) within (and in a related way external to) synthetic environments; and operating within and engaging in realizable experience within a synthetic or illusory virtual world rich with opportunities for creative imagination in ways that challenge and potentially extend our historic trajectory of knowledge and real-world experience (Hunsinger, 2008; Stuart, 2008). The perpetual movement, re-structuring and constant re-formation of knowledge (whether science based or otherwise) and our capacity to apply it to resolving new problems and old and exploring new opportunities, is a long-term driving force that will 'brook no delay' in the continuing enhancement of technology in its service. (Jonas, 1979) In turn, new technologies, as per the current amalgam instituted as new-media, is both a result of and a changing response to our growing and shifting knowledge base and a reflection of our capacity to extend knowledge through imaginative creativity.

There has been and continues to be, considerable debate among scholars on issues raised from the above and in considering the relationship(s) if any, between reality and perception. The whole argument of using technology to develop and present images or virtual representations derived from or representative of objects or events in the real world, as a valid process for furthering understandings of real objects or events, raises many issues, for example, in relation to the translation from a virtual construct premised on ideas, concepts and relationships expressed only in a synthetic environment, to a realizable construct or form or knowledge-based representation in the real-world. The very nature of the expression 'virtual reality' as an oxymoron (a conflict in terms or conjunction of contradictories (Oxford English Dictionary, 2005)) raises issues in itself. In the context of a synthetic or virtual world, the 'virtual' be it an expression of a particular style

or representation of a surrounding condition or environment, or as a subject of interest or aesthetic object (Manovich, 2001) or representation of a process or set of data, may be of itself a reality in that particular context. It may be seen, 'virtually' touched, moved, adjusted, altered, admired, denigrated, or simply ignored and left alone. Almost exactly as it may have been perceived had it been in a 'real' world context. 'Almost', in that unlike conditions in the real world, changes, improvements, movements, positioning, or other forms of interaction, may entirely ignore the apparent influences of physics and the laws of natural science in the real world, and may well be completely reversed at the click of a button!

With regard to the construct of 'reality', ostensibly as per in the 'real' world, there is the potential to consider the existence of 'virtual' conditions that impact on our existence and everyday lives in very 'real' ways. The construct of 'organization' for example can relate to the way we plan and put things together for a particular purpose or to the 'existence' of an 'organization' meaning a company or firm or group of people working together for a common purpose (Oxford English Dictionary, 2005). The notion of organization is a virtual construct, albeit with a physical (real?) presence through its assemblage of people into a particular community or group of communities and very much a part of daily life in the real world. The use of 'technology', as per new-media, to induce an existence of a virtual reality outside of the constraints of the real world of our physical being, may then in itself be considered an innovative extension of existing virtualization strategies in our normal 'real' daily life. Whilst this paper primarily addresses issues in relation to the introduction of new-media virtual reality and whilst certainly supportive of innovative new-media tools and systems, it is strongly the author's position not to reflect a perspective that could be misconstrued as cybernetic determinism. In turn, it is the author's perspective that the whole conceptual area of developing and instituting technological innovation and change is subject to and/or invokes argument about power, process, purpose, actuality, (Jonas, 1979; Sui & Goodchild, 2003) and potentially as Heidegger might express it: *just a further manifestation of technological thinking* (attributed to Heidegger in Coyne, 1999, p. 141).

The very focus on developing highly effective illusion through VR technology and systems has also attracted its fair share of protagonists, those for whom the road to unreality is an unacceptable violation of our humanity by the technocratic dream-weavers of cyber-business and Silicon Valley. From critique to complaint, from critical analysis to the vagaries of the Luddites, from careful observation to wild allusion, all may be found throughout the literature on virtual reality.

The apparent difficulties of correlating the established position of scientific and philosophical thought and argument with the potential use of synthetic or virtual objects, processes, and relationships in virtual world incarnations, may well be the kind of 'Bold Idea' that Professor Sir Karl Popper valued as an important component of valuable science. Popper argued that our life experience and observations of the world around us may only be at best the outer layer of a many layered reality. It is thus the scientist's task *daringly to conjecture what these inner realities are like* (Popper (1974) in Warburton, 1999, p. 278) and then to go further, to explore and test such ideas, or in Popperian terms: bold scientific conjectures. Whilst Popper's life experience essentially preceded contemporary virtual reality systems and new-media technology, the veracity of his arguments remain and exhort us to actively explore 'layer by layer' our world and the many (and at times volatile) artifacts that science and technology have introduced into the complex of our experience.

Popper's construct of bold scientific conjectures, (Popper, 1974) the observations of contemporary philosopher Thomas Kuhn in his paper addressing anomaly, the emergence of scientific discoveries and the institution of paradigm change, (Kuhn, 1996) and Christensen's constructs of discontinuous and disruptive technological innovations, (Christensen, 1997) would appear to sit readily with the potential

for advanced simulation and virtual reality technology and systems to institute, or at least be a pre-cursor of, paradigmatic change in the way we explore, examine, visualise, consider and make determinations about our world and its workings.

The potential for such change may be seen in the way we approach new information and knowledge-management technology, its application in the structures, processes and dynamics of contemporary commerce, its role in addressing the complexities of relationships in the world around us, and in the character and nature of personal and corporate competencies that we require in an increasingly information rich world (Johnson et al., 2008).

The continuing growth in complexity and dynamical capabilities of new media and the concomitant convergence of digital media (Yoffie, 1997; Pagani, 2003) will thus continue to challenge our concepts of the language and role of new media (Manovich, 2001) the applications for such new-media, particularly in the context of contemporary business – technology convergence (Andriole, 2005) and will see a growing diversity both within and between communities of practice associated with new-media virtual reality and new media *per se*. Communities of practice with interests as diverse as: interactive scientific visualization for data analysis; visualization as sketch-pad for multi-dimensional computer-aided design; visualization as immersive exploration and testing of new ideas, constructs and system level relationships; and creative visualization as dynamic virtual art form.

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