Products of negotiation and spaces of possibility: quantum systems and interactive media art

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The human subject and the production of reality in quantum systems and interactive media art

The division between subject and object is a natural result of our sensory impressions of the external world, which seem separate from the thoughts in our heads. When we stare at a painting we apprehend it as an object distinct from our conscious self. This binary split between the world 'out there' and the world in our heads is the foundation of classical logic. The very notion of objectivity is predicated on the idea that the universe is composed of subjects who are capable of remaining aloof from their objects. This is not the case when we confront interactive media art or quantum particles, neither of which can be considered 'objects' in any normal sense of the word. Instead we have systems - open, complex systems - in which we play a starring role. 'In the drama of existence we ourselves are both actors and spectators'.[1]

A work of interactive art, like a quantum system, injects the choices made by human beings 'directly into the causal structure. It specifies the effects of these probing actions upon the systems being probed'.[2] Together, subject and object are unified into an ontological whole. In both cases, the observer's actions are considered part of the system under observation. In both cases, the system is composed of an invisible component, digital or quantum, and a human component. In both cases, we are confronted with a variable phenomena or display that requires our intuitive understanding of 'things', be supplemented with a model based on 'systems' into which we are embedded as active components. 'We may state as characteristic of modern science that this scheme of isolable unit acting in one way causality has

1 Bohr, Neils "Essays, 1958-62, on Atomic Physics and Human Knowledge, New York: Wiley: 15.
2. Schwartz, Jeffrey M. ; Stapp, Henry P.; Beauregard Mario, "Quantum Physics in Neuroscience and Psychology: A New Model with Respect to Mind/Brain Interaction": 30.

proved to be insufficient. Hence the appearance in all fields of science, of notions like wholeness, holism, gestalt, etc ... systems of elements in mutual interaction.' [3]

From the macroscopic perspective of classical physics, you and the chair you are sitting on are distinct objects separated in space. However, from quantum perspective, you and the chair are two interacting systems of energy - a single complex system. If we cannot achieve, as cyberneticist Norbert Weiner says, 'a sufficiently loose coupling with the phenomena we are studying',[4] then we must consider ourselves as part of that phenomena - that system. The web based media art project, 'D-Cell' [5], by Casey Reas requires that the visitor 'touch' the art in order for it to come to 'life'. Try to touch a Rothko painting and you'll find yourself in handcuffs.

This notion of reality is, as French philosopher Nicholas Bourriaud describes, 'a product of negotiation' [6]. The same negotiation between the conflicting emotions and connotations occurs inside our heads when we encounter any work of art. But in our encounter with 'interactive art' this negotiation requires more than mental effort. Interactive art demands the engagement of our bodies. Interactive art demands to be 'touched' even if that contact is in cyberspace and mediated by a keyboard. For art theorist, Jack Burnham, this leads to a 'refocusing of aesthetic awareness-based on future scientific technological evolution - on matter-energy-information exchanges and away from the invention of solid artefacts.' [7] Burnham's prediction, made in the 1960's, of the 'death of the object' hasn't panned out, but the rise of a dialectical practice, such as interactive media, which has both object like characteristics (the hardware) and a non-object characteristics (the software) was acutely prescient. It is not just a coincidence that Burnham's 'matter-energy-information exchanges' find their corollary in the information-theoretic metaphors used by quantum theory.

The variable aesthetic output of interactive media art in response to human interaction is useful metaphor for grasping the elusive quality of quasi-mythological

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[3]. Bertalanffy, Ludwig von . *General System Theory*. New York: George Braziller, 1969: 44.

[4]. Weiner, Norbert. *Cybernetics: or Control and Communication in the Animal and the Machine*. Cambridge, Mass.: The MIT Press, 1948: 163.

[5]. http://www.singlecell.org/cr/index.html

[6]. Bourriaud, Nicolas. *Relational Aesthetics* (Translated by Simon Pleasance and Fronza Woods, Dijon, France, :Les presses du reel, 2002: 80.

[7]. Burnham, Jack. *Beyond Modern Sculpture*. New York: Braziller, 1968: 369.

quantum 'wave function'. The 'wave function' of quantum mechanics, is a model of the uncertain and complex behaviour of sub-atomic particles in response to our interactions. When a quantum particle is probed its 'wave function' collapses in response, offering a new 'field of possibilities' - which in turn is represented by a new wave function. Adopting this metaphor, we can say that object-based art is akin to classical particles, while interactive media art is more like the quantum wave function that produces an evolving 'space of possibilities'. The connections between interactive new media art and the invisible quantum world do not require a 'metaphoric stretch'. The similarities are too uncanny to ignore.

Non-locality, media art, and the World Wide Web

Quantum particle systems seem to possess the ability to communicate instantaneously with each other, defying our classical understanding of space and distance. The same experience is captured by the 'sense' of non-locality fostered by the World Wide Web, which seems to collapses space into mouse clicks and links. Though the speed of light limit is not broken during our web-mediated interactions, we often experience an immediacy that erases distance, creating a 'confounded sense of place and proximity.' [8]

Non-locality describes a state in which we have information about spatially disconnected components of complex systems. Quantum particles are 'points of intersection' of certain relations.' [9] The exchange and manipulation of information without regard to distance is one of the dynamic variables of both quantum systems and interactive media art. In both cases, our experience of non-locality is a product of our interaction with virtual phenomena: invisible communication networks or the immaterial probability wave.

Our encounter with a Rothko painting in a museum has a short-range character, but our encounter with a work of art that is networked can connect us to elements of the system that are thousands of miles away from each other. Compared to more traditional forms of public art practice, Internet art, which is accessible from the privacy of one's home, introduces a shift from the site-specific to the global, collapses

[8]. Dzekian, Vince . "Distributed Spatial Practice, as Applied to the Art of the Exhibition", *Invisible Culture,* Vol. 11, Dec. 2007: 11. http://www.rochester.edu/in_visible_culture/Issue_11/dziekan/Dziekan_print.pdf).
[9]. Cassirer, E., *"Determinism and Indeterminism in Modern Physics"*, New Haven: Yale University, 1956; (translation of "*Determinismus und Indeterminismus in der modern Physik"*, Goteborg: Elanders Boktryckeri Aktiebolag, 1937:180.)

boundaries between the private and public, and exists in a distributed non-local space. [10] The non-locality that Christiane Paul speaks of is a function of the Internet's elision of *our sense* of distance or spatial separation. Freed from geographic limits, a work of networked art can glow on the screens of thousands of computers at the same time. Richard Vickers helps Warhol keep his promise of future fame, in '15x15' [11] which allows anyone in the world with a web cam to upload their live feed, becoming part of a grid of videos. Vickers collapses 15 different locations into the space of your browser window.

Maciej Wisniewski's, 'Instant Places' [12] utilizes the non-local experience of the Internet to connect different computers to form a matrix that was free from the constraints of geography, time, and place. *Instant Places* featured predators (hawks) and prey (mice), which were able to 'move between different data places and communicated via instant messaging.' [13]

Ephemeral physicality

Just as a quantum particle has both a virtual and a physical dimension, so does a work of digital art, which exists as both invisible code and visual display. The dual nature of matter in quantum mechanics is mirrored by the dual nature of a work of digital art. Just as a photon is both a particle and a wave, a work of digital art is both a set of instructions and the execution of those instructions.

The dual nature of matter, as both virtual wave and physical particle is a product of our interactions with matter, rather than some intrinsic property of a 'reality' with an objective, independent existence. 'Virtual states are part of the realm of potentiality in physical reality because they contain the future empirical possibilities of the universe.' [14] This is eerily reminiscent of the way invisible software contains the potential for the future 'empirical' (quantifiable) audio-visual outputs it displays in response to human interaction.

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[10]. Paul, Christian. "Digital Art / Public Art: Governance and Agency in the Networked Commons" in Sandra Braman and Thomas Malaby (eds.), *Command Lines: The Emergence of Governance in Global Cyberspace*, First Monday, Peer-Reviewed Journal on the Internet, Special Issue #7, November 2006.

[11]. HTTP://WWW.15X15.LINCOLN.AC.UK/

[12]. HTTP://ZKM.DE/FUTURECINEMA/WISNIEWSKI_WERK_E.HTML

[13]. Greene, Brian. *The Fabric of the Cosmos*. New York: Vintage Books, 2004: 131-132.

[14]. Schafer, Lothar "Nonempircal reality: Transcending the physical and Spiritual in the Order of the One", *Zygon*, vol. 43, no. 2 (June 2008): 334.

Uncertainty

Quantum mechanics reveals something much more fundamentally odd about the character of 'reality': the observer cannot look at a quantum particle without affecting it. The process of measurement translates the virtual to the physical. When the ensemble of quantum mechanical possibilities (the wave function) breaks down, one of the various possible outcomes becomes reality. When detection happens, new information is put into the world [15]. This is not an epistemological issue, but rather ontological. There is a virtual invisible dimension to reality that directly affects the material 'visible' dimension in a way that is impossible to completely quantify.

The project 'A-Volve' [16] by Christa Sommerer & Laurent Mignonneau, translates the physical input of visitors interacting with a giant touch-screen into a digital ecosystem of strange luminous creatures fighting for survival. The hidden algorithms written by the artists, function as the 'laws of nature'. The magnetic spin of a sub-atomic inhabitant of the quantum world can be said to point both up and down at the same time. Quantum particles thus exist in 'virtual states', which are unthinkable within the classical paradigms of objective certainty. Instead we are 'left with a system represented as a mixture of various possibilities, like being in two places at once'. [17] This state of superposition, a state of unrealized potential, is maintained until that quantum bit interacts with something beyond itself, for instance the detectors of quantum physicists. In the quantum world objective measurement is a fiction. Measurement is an interaction or, as physicist Antoine Zellinger says, 'an act of creation'. [18]

Adopting a digital metaphor, we can say the act of measurement is the variable input into the quantum system. The interaction between the measuring device and the quantum wave function of the particles under investigation is the 'throughput' function: the quasi-mythological collapsing wave function. The output is a piece of concrete information: either the location or the velocity of a sub-atomic particle.

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[15]. Suarez, Antoine. "Classical Demons and Quantum Angels: on 't Hooft's Deterministic Quantum Mechanics", arXiv:0705.3974, Volume 1, (2007): 11.
[16]. http://www.medienkunstnetz.de/works/a-volve/
[17]. Zeilinger, Anton . "Split World: Book Review of Decoherence and the Quantum-to-Classical Transition" by Maximilian Schosshaurer, (http://www.univie.ac.at/qfp/publications3/pdffiles/2008-04.pdf), 2.
[18]. Anton Zeilinger as paraphrased by Suarez in, "Classical Demons and Quantum Angels", 11.

If we click on the Internet project, 'Tripolar' [19] by Scott Snibe, and drag our mouse the black lines on the screen respond by vibrating as if alive. However, the moment we let go of our mouse Tripolar flips into a new 'fixed' form or static state. In quantum terms, the visitor's interaction is like a measurement that causes a 'field of possibilities' to 'collapse' into an 'observable'. Tripolar's 'observable' is a visual display, whereas the quantum 'observable' is a piece of quantified information: velocity or position. Just as in quantum mechanics, the visitor to Tripolar is not 'really' interacting with the visible 'object', but with the invisible system that lies beneath. The quantum scientist probes invisible sub-atomic particles, whereas the visitor to Tripolar probes the invisible software. The software that lays hidden beneath all works of digital art is a metaphor for the laws of nature that lies hidden behind quantum particles.

Digital artist Alan Peacock describes interactive art as 'a site of Uncertainty, problematized actions, and entropic effects.' [20] The exact same thing could be said of quantum systems. In both cases, the human subject's freedom of action means that neither quantum measurements, nor the aesthetic effects (of interactive media) are predetermined qualities. Both require the participation and creative input of the human subject interacting with an invisible component: quantum or digital. In both cases, we cannot predetermine the outcome of these interactions with absolute certainty.

Conclusion

Quantum systems and interactive media are variable entities that evolve in time in response to human action. In both cases, our explorations become inputs into a system that processes according to set of rules, either the 'laws of nature' or the algorithms written by digital artists. In both cases, the visible world has a virtual shadow, the quantum wave function or the invisible software that lurks behind digital media. In both cases, our intuitive sense of subject/object spatial separateness is challenged by our experience with quantum systems and interactive media. Computers linked by high-speed telecommunication networks evoke quantum particles in state of entanglement.

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19. HTTP://ARTPORT.WHITNEY.ORG/COMMISSIONS/CODEDOC/SNIBBE/TRIPOLAR.HTML
20. Peacock, Alan "Toward an Aesthetic of the Interactive" (www.soundtoys.Net/journal), 4.

‘Quantum Reality’ is more than ‘pointer readings’ and differential equations. We need to rely on ‘other’ means of understanding. Enter the artist whose techniques of understanding are not limited by the need to quantify analytically, but rather the will to poetically synthesize. The full implications of entanglement, superposition, and non-locality may be beyond our grasp, but artists who utilize software and telecommunications networks are able to evoke aspects of the phenomenon. Here art fills the gaps in our scientific understanding of the world.