MANIPULATING STEM CELLS IN NEW MEDIA LABS: DEVELOPING A PROTOCOL TEMPLATE TOWARD AN INNOVATIVE UNDERSTANDING OF CANCER

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Abstract
This statement presents a draft of a protocol template designed to manipulate stem cells within the context of a cooperation between biology labs and new media arts labs. This protocol aims at building a methodological synthesis to understand cancerous cells using not only lab facilities but also new media arts tools, applications and vision. The template illustrates potential technical, conceptual and aesthetic inputs derived from a new media arts lab. On the other hand, three output channels have been emphasized to contribute to stem cell research, new media arts research and public engagement.

So far, the most prominent artistic contributions regarding cancer have come from the field of art therapy [1], with art therapists concentrating on improving patients’ well-being and comfort as a defense mechanism against cancer-related psychological disorders. However, from the new media arts perspective, and without denying the value of art therapy, such artistic practices remain limited in focus to overcoming the psychological impacts of cancer on patients’ mental and emotional health [2].

In contrast, new empirical methodologies in the sciences of visual arts and practice-based research in new media labs, particularly in experimental bio arts, have generated several approaches that might be worthy enough to be adopted as integral pieces to biological research processes regarding understanding cancerous cells [3].

Stem cell research is one of the most promising trends for understanding and treating cancer [4], to which end stem cells can be cultured, induced, reprogrammed and so on. Stem cells are distinguished by two unique characteristics: First, they are unspecified cells capable of renewing themselves through cell division processes [5]. Second, they can be induced to make specified cell types for performing special functions.

Stem cells’ properties as biological raw material that can be induced to derive almost all cell types also imply a level of immateriality, in which material has no specific identity. Hence, processing such material in new media labs could unleash unlimited approaches to understanding stem cell behavior.

New media arts practice has seen few attempts to deal with stem cells within an artistic context, though a limited number of stem cell research institutes issue open calls for artists to express their vision with stem cells as a material [6]. However, most of these attempts remain individual and present a one-sided artistic benefit.

Therefore, this article introduces a project called New-Media Arts Protocol to study Stem Cells (NMAP-SC). During this project, I conducted several interviews with new media artists and biologists to investigate the validity of developing a flexible, unlimited protocol among biologists and new media artists in order to work on practice-led research projects [7] toward deeper understanding of stem cells.

As a result of analysis of more than 100 interviews with specialists worldwide, I designed a draft of a protocol template.

Protocol Outline

Overall Vision
I designed NMAP-SC to create a joint methodological framework regarding shareable custom-made studies between new media arts labs and biological labs in order to enhance our understanding of stem cells and related issues.

Outputs and Inputs Balance
The mutual benefits for media arts labs and biological labs are the core of this protocol, in which arts labs’ outputs contribute to the core of the biological labs’ research and vice versa. The new-media labs’ contributions to the biological research and the biological research’s contributions to new media arts share equal priority.

Structural Framework
As Fig. 1 illustrates, the protocol’s structure defines only the main paths of the processes’ flow between the bio labs and the new media labs in shareable stem cell experiments. Under every path there is a customizable area that can be filled depending on each particular experiment. Conceptually, the protocol’s structure may lend credibility to the assumption that processing stem cells inside new media labs embodies the materiality of the humanitarian dimensions behind stem cell research in biological labs [8]. Therefore, integrating both sides in one path would give us a clearer understanding of the stem cell as raw material of biological identity.

Protocol Instructions

Inputs
In parallel with the orthodox inputs of the biological labs, new media arts labs can also provide inputs in order to manipulate stem cells through separate technical, conceptual and aesthetic channels. The technical channel may provide visualization for analyzing stem cells in different biological phases. It also would contribute to encoding the internal biological transition via detection techniques and computer vision technology. Some custom interactive systems can be attached to a stem cell dish in order to simulate replating processes. The conceptual channel, on other hand, would unleash unlimited possibilities to conceptualize stem cells as an artistic medium within a new media context. The aesthetic channel, in advanced steps, would interpret the biological processes as an autonomous aesthetic system [9], in which several aesthetic approaches would be investigated toward reinterpreting the biological dimensions of the interactive arts depending on a stem cell–based interactive model.

Outputs
According to the protocol’s goals, the outputs must be divided into three categories as follows:

*Outputs that address core biological research: This kind of output usually answers the questions: Which part of the process inside the media arts lab is important for biological labs? How can experimental methodologies in new media arts facilitate new strategies using stem cells? Related issues will arise depending on the experiment.*
Outputs that seek public engagement: This kind of output represents the final result of the media art experiments, usually in the form of artistic exhibitions, interactive installation, game art, etc. Through these platforms, scientific concepts can pass into the public arena due to their ability to demystify scientific data. Further, passing the scientific results of such research into the public arena will create several chances to ethically refine codes of practice in such critical fields.

Outputs that address core new media arts research: Unlimited studies in new media art theory and practice would be investigated through this kind of output, in which stem cells are examined as an artistic medium implying new conceptual and aesthetic aspects in media arts practices.

Early Validity Examination
As I prepared a draft of the NMAP-SC, an open call was announced by SciArt Center in New York in order to invite artists for a juried exhibition by the Cambridge Stem Cell Institute at the University of Cambridge, U.K., asking: If stem cells are the artistic medium by which we design our future, what does this future look like?

Having an early opportunity to test NMAP-SC, I began a multiphase artistic project called Bio Pixel (Fig. 2). This ongoing project aims at developing a visual generative system derived from an embryonic mouse stem cell [10].

In accordance with the NMAP-SC template’s first step, biologists at the Egyptian National Institute of Cancer pointed out their experiment and its target of studying mechanisms for cell division and autophagy in embryonic stem cells. As a second step of the protocol, I determined the technical approaches that could be adopted by my new media arts lab to process scientific experiments. Next, embryonic mouse stem cells were then shipped to my new media arts lab. Technically, coding, detecting and visualization techniques were adopted as a fourth step, in which a motion detector translated every speed category into specific colored pixels in a particular position in order to conclude general movement maps of a current stem cell’s biological phases.

Birth, death, and the phases in between are biologically encoded within stem cells and processed by the actions of cell division and autophagy [11]. Consequently, as a fifth step, the project sought a digital remodeling of the biological transitions between these phases inside stem cells by detecting physical internal movements in an embryonic stem cell under microscopy. Monitoring and translating the internal stem cell movements would allow visual interpretation of the cellular behavior. The interpreted biological processes would therefore metaphorically provide a parallel digital constitution in which pixels behave as a unified cell. Hence, this artwork not only looks for an imagined stem cell–based world but mainly investigates an empirical methodology that provides a stem cell–based open source to rebuild our own cellular worlds.

Aesthetically, as a sixth step, the translated images reveal the relationship between the flow of the processes throughout stem cells’ biological itinerary and the potential aesthetics of the architecture of the remodeled stem cells digitally [12].

Through working with biologists under the umbrella of NMAP-SC, at the Egyptian National institute of Cancer, we achieved the solid principles of the protocol in which three categories of outputs have been investigated: (1) the processes of the art making have contributed to the core processes of the scientific experiment; (2) the output has been acknowledged as an artwork; and (3) the visual results will be shown as an artistic exhibition for public engagement [13].
Cancer Stem Cell Research through NMAP-SC

Under the assumption that cancer is primarily driven by a smaller population of stem cells [14], NMAP-SC’s strategy can work effectively toward a comprehensive visual rendition of the cancer state. With this protocol, new media labs can demystify several issues regarding cancerous cells. Further, cooperation would advance basic information on cancer in nonacademic communities in order to enhance public awareness. Moreover, new media labs can facilitate complicated empirical investigations that could interact with tumor samples in order to reveal cancer’s actions visually and decode their destructive processes within an interactive context. In order to present potential conflicts that may arise, e.g. if artists’ work is not acknowledged because collaborator scientists evaluate the art within a scientific rubric, codes of practice in both kinds of labs must be reviewed. On the other hand, new media artists who are eligible to participate in such protocols must have interdisciplinary backgrounds in media arts as a major and biology as a minor to insure minimal common principles.

This concise statement must be distributed as a protocol template with its background, outline, and structure in the artistic and scientific communities. It can be filled and manipulated depending on every single experiment [15]. Further, it would also be used as a basic blueprint for more complicated protocols for a specific stem cell–based experimental project. Applying such a protocol will undoubtedly raise controversial issues regarding ethical dimensions and the current codes of practice in both media arts and biological research.

All these issues are included as a part of a comprehensive plan to develop this protocol from its current beta version into an accredited version (see online supplemental material).

References and Notes


5. U.S. National Institutes of Health Stem Cell Information Home Page, Stem Cell Information (2016): https://stemcell.nih.gov/info/basics/ii.htm (accessed 2 May 2018). Cell division is the process in which a parent cell divides, giving rise to two or more daughter cells. It is an essential biological process in many organisms. It is the means used by multicellular organisms in order to grow, rejuvenate (repair) and reproduce.


9. Autonomous describes things that function separately or independently. The corresponding noun is autonomy, referring to the state of existing or functioning independently.

10. Embryonic stem cells (ESCs) are stem cells derived from the undifferentiated inner mass cells of a human/animal embryo. They are pluripotent, meaning they are able to grow (i.e. differentiate) into all derivatives of the three primary germ layers: ectoderm, endoderm and mesoderm.

11. Autophagy: the natural, regulated, destructive mechanism of the cell that disassembles unnecessary or dysfunctional components.


13. The early output of this project has been selected for a juried exhibition by the SciArt Center and therefore will be exhibited and archived at the Cambridge Stem Cell Institute, June 2018. It was also exhibited at New York Hall of Science, New York City, U.S.A., September 2018: www.sciartiinitiative.org/infinite-potentials.html (accessed 15 December 2020).
