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**Interactive Environments: Opportunities for Social
Innovation and Public Health Initiatives**

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Abstract: How to keep people in a “good health”, longer and healthier life is more than just a phrase listed in a sustainable strategies it became crucial issue for any future social innovation initiative and community needs. New technologies and its application in everyday living surrounding are affecting a way we are interacting between each other and with services around us. As a result, we are facing huge psychological and cultural shift in human behavior and raising of new social practices. We are in need of using new approaches and models in order to provoke human behavior change which is more than ever depending on content and context users can reach in interactive environments they are approaching through their devices or in a physical space. New powerful playground for social innovations is born.

Keywords: Sustainability; Social Innovation; Well-being; Design for Health Behavior Change; Interactive Environments; Multimodal Storytelling; Digital Technology; Sustainable Development

1. Introduction

This paper refers to certain aspects of the EU Sustainable Development Strategy, supported projects and design potentials for social innovation within health care system and how to keep people in a “good health”, longer and healthier life. We are facing fast growing technological and social transformations which have induced distinction between newly developed structures, social needs and institutions. New human behavioral practices, supported with new technology and usage of various media in everyday routine, are forcing institutions to be more open to them. As a result, recent innovation tendencies are more oriented toward self-management of diseases and public health than to hospitals or more around active ageing than around pension provision. Significant attention in that process has been given to new technologies and its capacity to be easily adopted in development of desired social needs and effective services delivery. Examples include use of assistive devices for the elderly, mLearning and eLearning applications, applications and diagnostic tools for self-care, smart living environments which could increase quality of everyday life, etc. Also, very important issue in that context is to provide people with the solutions to ‘co-design’, work together to develop solutions such as online platforms where clinician and patients are connected and mutually engaged in further service development. Hence, in order to fulfill users’ need for participation and interaction between each other and stakeholders, series of methods and approaches (supported with the new technology) were used within the public sector to re-design services. We could say that health represents major

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sector of the economy and as such the fastest growing in the same time. Recently, public health type of services tends to be more community-based and deploy social networks. (Murray, Caulier-Grice & Mulgan, 2010). Much of an innovation comes from the creative blending of ideas from multiple sources. For example, bringing together diagnostic computer programmes, call centers and nurses to provide new kinds of healthcare. (Murray, Caulier-Grice & Mulgan, 2010).

The tools of innovation are still under development but clearly showing needs for a mix of different elements and ideas. For example, innovators combining the funding methods used for science and venture capital with those from tendering and grant giving. Others are combining ethnography, visualization techniques from product design, user involvement ideas from social movements, and commissioning methods from the public sector. (Murray, Caulier-Grice & Mulgan, 2010)

In this paper through listed examples and responsive interactive environment experiment author has intention to widen creative mix of ideas and interactive media technologies space toward innovative solutions which will meet social needs and establish new social relationships or collaborations. More than ever design approaches are focusing on human engagement which could achieve social and public well-being. These are becoming significant for the sustainable development and as such framed within the context of social innovation. (Manzini, 2009; Emilson, Seravalli, & Hillgren, 2011).

The result of such processes and applied models could be new services just like any innovation [4](Murray, Caulier-Grice & Mulgan, 2010), but could also be an idea or social movement which affects lasting human behavior change (Bjögvinsson, Ehn, & Hillgren, 2012).¹ Use of Design for Behavior Change approach to change society and enhance society's possibilities to act upon rising public health issues in the EU and worldwide is what this paper proposes. By collecting many methods together we believe that processes of creative recombination and experimentation toward sustainable social innovations will become more efficient and human-centered.

2. Background

Nowadays social innovation has been highly positioned on every political agenda (Haxeltine, Wittmayer, Avelino, Kemp, Weaver, Backhaus & O'Riordan, 2013)², as it carries a great potentials to respond to the multiple social, economic and environmental crises that are faced by societies all over the world. In Europe, it is clear that public sector has difficulties to work on solutions for existing crises such as budget cuts, unemployment, ageing, migration, climate change etc. Business are not interested to get involved as they do not see profitability through their engagement toward solutions development for those issues. As such, civil society and individual citizens are persuaded to react and to seek new ways through social innovation and hybrid organizations or a multitude of attempts across sectors as social innovation are both good for society and enhance society's capacity to act and can emerge from any sector (TEPSIE, 2014). Essential requirement for social innovations are to engage with a social problem in a way that is "more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals" (Phills, Deiglmeier, & Miller, 2008). More explicitly, as Phills et al. (Phills, Deiglmeier, & Miller, 2008) put it, a social innovation can appear as a product, production process, or technology, but also a principle, an idea, a piece of legislation, a social movement, an intervention, or some

¹ Design Council: What's Dott? [online]. <http://www.dottcornwall.com/aboutdott/whats-dott> (2010), [accessed 27 October 2011].

² BEPA (2014). *Social Innovation. A Decade of Changes. A BEPA report. Bureau of European Policy Advisors*. Available at: http://espas.eu/orbis/sites/default/files/generated/document/en/social_innovation_decade_of_changes.pdf.

combination of them. It is very important to understand that social innovations are socially and politically constructed, and are, therefore, not value neutral (Caulier-Grice, Davies, Patrick, & Norman, 2012). It has capabilities to respond to ongoing social demands by means that affect the process of social interactions, and it is very concerned with wellbeing (Caulier-Grice, Davies, Patrick, & Norman, 2012).¹, suggesting a number of common features and core elements of social innovation, which can be visualized in the following (Fig. 1).



Figure 1. Core elements and common features of social innovation

Source: (Caulier-Grice et al., 2012)

Over the last decades many policies and actions have been done with idea to affect gradually health and health systems across Europe. The recent EU renewed social agenda recognizes health as a key issues for a well-being of the EU citizens in the 21st century. The EU's economy strategy as well as Sustainable Development Strategy clearly underline the importance of health issues within challenges in the sustainable development and growth in the EU in the upcoming years². During the period 2007-2013 more than €5 billion have been allocated for investment in health projects in particular to improve health infrastructure and services and to train professionals throughout the EU³. "Together for health"⁴ the EU health strategy supports Europe 2020 strategy which has intention to transform the European Union into sustainable society which will has continues economic growth embedded into ecological living environment and population in good health. According to those strategic tendencies the third EU health programme has started in 2014 and will last till 2020⁵. The programme has 4 overarching objectives. It seeks to: promote health, prevent diseases and foster supportive environments for healthy lifestyles taking into account the 'health in all policies' principle, protect Union citizens from serious cross-border health threats, contribute to innovative, efficient and sustainable health systems, facilitate access to better and safer healthcare for Union citizens. From other side it is clear that the health demands of the 21st century are different than those from 20th

¹ BEPA (2010). *Empowering people, driving change: Social innovation in the European Union*. Bureau of European Policy Advisors. Available at: http://ec.europa.eu/ewsi/UDRW/images/items/doc1_17731_35611801.pdf.

² <http://ec.europa.eu/environment/eussd/>.

³ http://ec.europa.eu/health/health_policies/health_in_eu_initiatives/index_en.htm.

⁴ http://ec.europa.eu/health/strategy/policy/index_en.htm.

⁵ http://ec.europa.eu/health/programme/policy/2014-2020/index_en.htm.

century and require different approaches to healthcare and construction of new services.¹ Hence, need for new models and new technologies which will successfully connect healthcare provided by the state with needs and initiative done by communities became a crucial tendency to consider within social innovation landscape. For that purpose we also need to empower patients to become more than passive recipients of care and help them to look after themselves which requires huge cultural shift too.

Digital technology could play significant role in this transformations within health sector as it is widely used in all aspects of our lives such as finding and sharing information, assisting in taking actions, educating, helping us in interaction with each other as well as using all sorts of services which we consider very important for our everyday routine. From that perspective people can use infrastructure of the existing interactive environment ecosystem to do more for themselves as professionals are no longer the only gateway to access to health information and support. For example, technology can support the patient doctor relationship such as in Buddy APP where it's possible to put together therapists and patients in joint efforts to reinforce positive behavior by detecting and mapping reasons and triggers for negative mood². The similar example of patient-doctor relationship establishment by using interactive technology is Doctor Mole, application which can help people assess the risk profile of a mole and generates automatic reminders³. The important benefit of using new technology is that it can help people identify and deal with problems in early stages, ultimately leading to less reactive and expensive treatments. The digital platform WebGP combines diagnostic tools that patients can use online to determine their health state and then, if they want, to require online consultancy before they decided to see a doctor⁴. Doc Ready is an application that helps young people with mental illness understand their condition and get the most out of their appointments with clinicians through simple preparation tools⁵. The HP Digital Hospital fully embodies the potential for technology to improve outcomes, and save money all while doing more. HP's digital hospital is a fully integrated, patient-centric information infrastructure which allows the sharing of data between doctors, nurses, patients and their loved ones⁶.

The interactive space of social media and online social interactions has been used to co-ordinate support within specialized social networking sites such as Tyze, which helps vulnerable people to connect with networks of formal and informal care⁷. It helps caregivers, professionals, friends and family to remain informed and manage their separate but related care responsibilities. Significance of social aspects are also very important to consider as part of the various gadgets and application development, promoting fitness and wellbeing by controlling physical activities and food consumption. Online interactions between individual and groups, over the various apps and platforms developed for that purpose, appear to be powerful and effective motivation for people to exercise, co-ordinate and change their lifestyle habits. As results, online health trainers became a new phenomenon where people are in position to offer services and support community in public health initiatives and

¹ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

² Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

³ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

⁴ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

⁵ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

⁶ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

⁷ Wilson, Sarah & Langford, Katharine. 10 ideas for 21st century healthcare, Available at: <http://www.innovationunit.org/sites/default/files/DIGITAL%20VERSION%20final%20.pdf>.

wellbeing.

Beside mentioned user assistance and social aspects, interactive environment space allow us to play around with gamification in healthcare. The number of pilot projects and development companies who are willing to act in that direction are increasing during last few years but still it is not clear what kind of benefits for patient health behavior change this approach could really obtain. The main future obstacle could be entertaining aspect as patients are still considering their health and wellness through consumer mentality. Interesting projects which could be selected within interactive gaming environments are the Pact mobile app where players are exposed to a risk of losing money if they don't follow through on their commitment to exercise¹. Players are obligated to set up their personal goals to eat right and exercise several times each week. Also, they must define a financial amount that they are willing to lose if they don't follow through on their promise. Dedicated players who exercise are in a position to get paid by those who don't keep their "pact," creating an online community where some users are paying others. It is obvious that The Pact application concept applied to improving health has some parallels to online gambling. However, gamification concepts and principles could be important factor in successful usage of digital technologies and interactive environments with the social innovation processes and health behavior change as people are naturally competitive and like to compare themselves to others. For example, games such as Patient Partner tries to help patients to improve their medication adherence, they are entering virtual space and learning about the various clinical outcomes that may result if they fail to adequately manage their health conditions².

Monster Manor is oriented toward young children with diabetes and tend to engage them to take their insulin and be entertained while they are doing it³. The Pain Squad iPhone app is conceptualized to help children dealing with cancer track their symptoms so their clinical care team can help them to manage their pain⁴. Through these examples we could say that gamification principles have been implemented into interactive virtual environment has a great potential to help users to improve their health by increasing their engagement and motivation to receive ongoing feedback, reminders and status updates about their progress in caring for their own health.

The presented examples demonstrate a possibilities for social innovation and health behavior change thanks to new technology and type of interactions capable to achieve in that context. Thank to technology we are connected with communities and available services around us like never before. It is easy to access the information and connect with people with common illness and professional in order to manage personal health without leaving home. Within such interactive (constantly approachable) health care ecosystem. Everybody from clinicians to people on the street are involve in public health initiatives and has opportunity to participate in social innovation processes with focus on providing health and wellbeing for themselves and people around them. If we start using most of the interactive digital resources for the purpose of education, improving engagement with the patients, self-care and change of lifestyle the future of health services could be directed toward providing more time for clinicians, more preventive care and less damage control.

¹ Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

² Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

³ Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

⁴ Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

3. Responsive Interactive Environment for Health Behavior Change

The interactive installation *InnerBody* plays with human fears which are eternal. They do not know for any limits, and they persist in humans since birth until the end of life. The strongest primordial fears obsessing the human mind are the fear of death and illness. These fears do not weaken over years, but help us survive and prevent us from making reckless decisions. The fear of death reminds us of how short life is and that we should spend it in a meaningful way, surrounded by our loved ones, doing things that fulfill us. By provoking such emotions, the installation conceptual idea has been to remind us on physiological body existence, which runs all our life processes and should be “maintained”, the same way we are taking care about our spiritual or physical body. Furthermore, through the induced awareness and feelings by using multimodal storytelling, metaphors and aesthetical environment to affect user actions toward changes of health habits and prevention of illness.

The installation was exposed in 2014, at the medieval Belgrade fort in the part which was used to be a gun storage. The entrance of the installation looked like improvised field ambulance from the middle ages with hanging white sheets, MRI scans and monitor showing video recorder from the MRI examination author has done on himself for the purpose of the installation. The video from the author’s MRI examination with all dramatic expressions which were readable on his face and intensive MRI scanner sound (which is in the background of the installation throughout all the time) were important parts of the installation and narration behind it (Figure 1.).

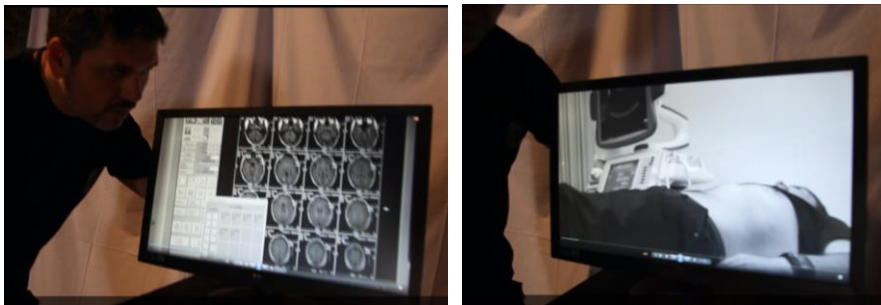


Figure 1. Video which shows author’s MRI examination.

After passing by the monitor and white sheets on the entrance the user enters the main space of the installation. The space consist of projected messages on the wall and the installation interface as main interaction point between visitors and the installation’s triggered outputs (Fig. 2.).



Figure 2. The Inner Body Heart Interface, the output occurs when user grabs it.

The installation interface is stylized model of a human heart and cardio-vascular system as input device, and the output device is wall projection. Users had to touch and grab by their hand the heart sculpture placed on the tube which was filed with the blood in same volume as in average adult body (Fig. 3.). The system reacted to human touch and triggered audio-visual respond to the user. The interaction concept was based on simulated medical examination as the system made feedback on user

gesture of grabbing the heart interface. The *InnerBody* interface manipulated with a human heart as a symbolic representation of vitality, beginning and ending, living and dying, health and sickness¹.



Figure 3. The Inner Body model of a human heart and cardio-vascular system interface

With the intensive tactile gesture performed on the model of a human heart, together with the additional colors, shapes and objects which were part of the interface, the idea was to achieve experience which will lead to desired health behavioral change. Hence, to provoke such fast and radical immersion of the users, as mentioned, we paid a lot of attention to environment where interactions were happening. So, beside white sheets, we used smell characteristic for the hospitals, played MRI scan sound and loud beats of the heart during the fake examination². People were frightened no matter they knew it was not real and that all was a part of directed performance. All of them understood the metaphors and the communication between them and the system was clear and easily understandable. What we used in this case to provoke desirable effects were deeply inherited fears in our consciousness we react on subconsciously.

The video which is recorder at the author's MRI exam represents audio-visual testimony of the traumatic experience author passed during the process of the installation design (Fig. 4.). The sound used is the one generate by MRI tube during scanning. In reality we are usually afraid of such exams as it could reveal unexpected body conditions, we had a change to prevent in case of different health related behavior and physiological body treatment (which is in focus of the installation and its narrative).



Figure 4. Video which start installation narrative and shows author's personal drama

The Inner Body heart interface invoked metaphors based on shapes and forms recognition, and on correlation with our physiological and cognitive perception of the used object. Important role in case of the heart interface was given to the ambient in which the interaction was happening, together with multimodal perception and embedded metaphors which empowered user experience significantly.

¹ Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

² Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.

Upon this aesthetical foundation, the interactive installation *Inner Body* tended to induce, through interaction with the heart interface and virtual outputs projected on the wall, fear of dead and sickness. On a subconscious level the ideas of mortality and focusing on real life values (health and wellbeing) were tried to be communicated with the users ¹ (Fig.5.).



Figure 5. The Inner Body human heart interface placed in front of the wall projection

After entering the central space of the installation user/visitor has been textually introduced to the nature of a so called *Preventive Diagnosis by an Infrared Scanner* and instructed how to begin with the exam (Fig. 6.).

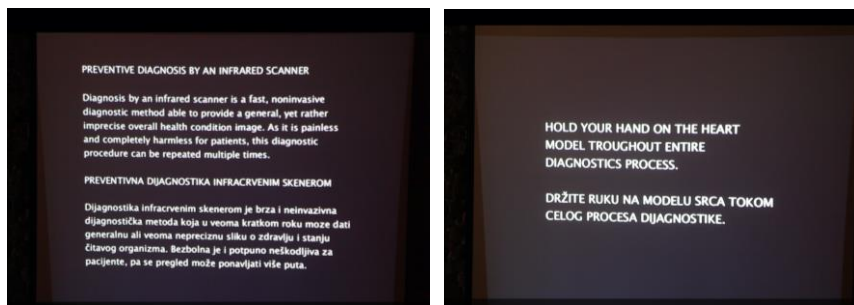


Figure 6. Text messages representing introduction to (fake) medical exam and instructions.

After grabbing the heart interface and starting exam, user has been guided through audio-visual narrative experience of fake medical exam just entered. The most dramatic moment, which supposed to heavily reflect on user experience and to trigger desired health behavioral change, has been when user start to get alerts from the system about potential found anomalies followed with the strong sound of heart beats and visual representation of a heartbeat monitor (Fig. 7.). Even the modulation of a heartbeats sound and presented body conditions are carefully directed by the author and revealed as fake in the finally projected text message, multimodal storytelling approach provided authentic reactions of the users who attributed artificial audio-visual information to their own body and health condition. The last projected message has also important persuasive role as it tries to educate us about importance of life and fearless care of our *Innerbody* (subconsciously our health condition). This reflections on user experience within the installation and afterward health considered behavioral changes were analyzed as potential opportunities of using responsive interactive environments and multimodal storytelling in a communities and living surroundings as a trigger for social innovation, health behavior change and well-being.

¹Kim, Joseph. Gamification in healthcare isn't just about playing games, Available at: <http://searchhealthit.techtarget.com/opinion/Gamification-in-healthcare-isnt-just-about-playing-games>.



Figure 7. Animation with different phases of the exam and alerts on found anomalies.

The data in the experiment were collected from the following sources:

- Personal observation – the data was collected on the spot, while the users were interacting with the installation, before entering, and after leaving the installation; and
- User interview – this method was conducted after users' interaction with the installation.

Two groups of users participated in the *InnerBody* interface. The first group consisted of participants who were introduced to the installation narrative prior entering it. They were told about the idea, the purpose, and they knew what to expect. The second group included the participants who did not know anything about the purpose and the functioning of the installation prior entering and, hence, did not know what to expect as an outcome. Total number of 32 participants were personally observed while interacting with the installation – 6 of them were told about the purposed of the installation, while 26 were not. The participants understood the metaphors used in the installation, since the communication between them and the system was clear, easily understandable, and interactive. However, the interactive environment was so powerful and influencing, especially in a way of attacking human senses, that it created substantial amount of fear and managed to change the behaviour of the participants who had been introduced with the installation narrative in the first place. We actually used deeply inherited fears in our consciousness we react on subconsciously, in order to provoke desirable effects. We concluded that despite the fact our participants had been absolutely aware that it was fake examination, they started being afraid of their deepest fears. Based on that, we found interactive media art and multimodal storytelling as potential environments for design of health behaviour change.

4. Conclusion and Future Directions

Digital technology and various interactive environments could become crucial factors in future EU Health Programme fulfillment of the 4 overarching objectives. Especially we should follow its contribution to innovative, efficient and sustainable health systems where people would be able to do more for themselves because the professionals will not anymore act as the only gateway to access to health information and support. In that context we could conceptualize social innovations on new models and new technologies capable of connecting individuals and community health initiatives with health care provided by the state. Crucial behavior change in that sense would be to transform people from passive recipients of care to active participants in “good health” not only for themselves but also for the people around. For that we would need not only technological but also cultural and mental shift which could be supported by enriching living surrounding with responsive interactive environments capable of education us, triggering our emotions and health prevention, such as InnerBody example.

Through listed examples author of this paper tends to present variety of options for social innovations in health sector new service development and wellbeing. Focus is on type of the interactions supported with the solutions (social, online tools, online assistance, interactions with physical space) and different approaches to achieve user engagement (gamification, multisensory storytelling, networking and content distribution). Future use of those technologies, methods and approaches and directions how to adjust them to human social needs in order to provide more preventive care toward healthier communities and wellbeing could become leading factor in social innovation within the EU health care system.

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