Issue 2 / 2013

CyberTherapy & Rehabilitation

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fMRI-VR: Gateway to Complex Brain Processes

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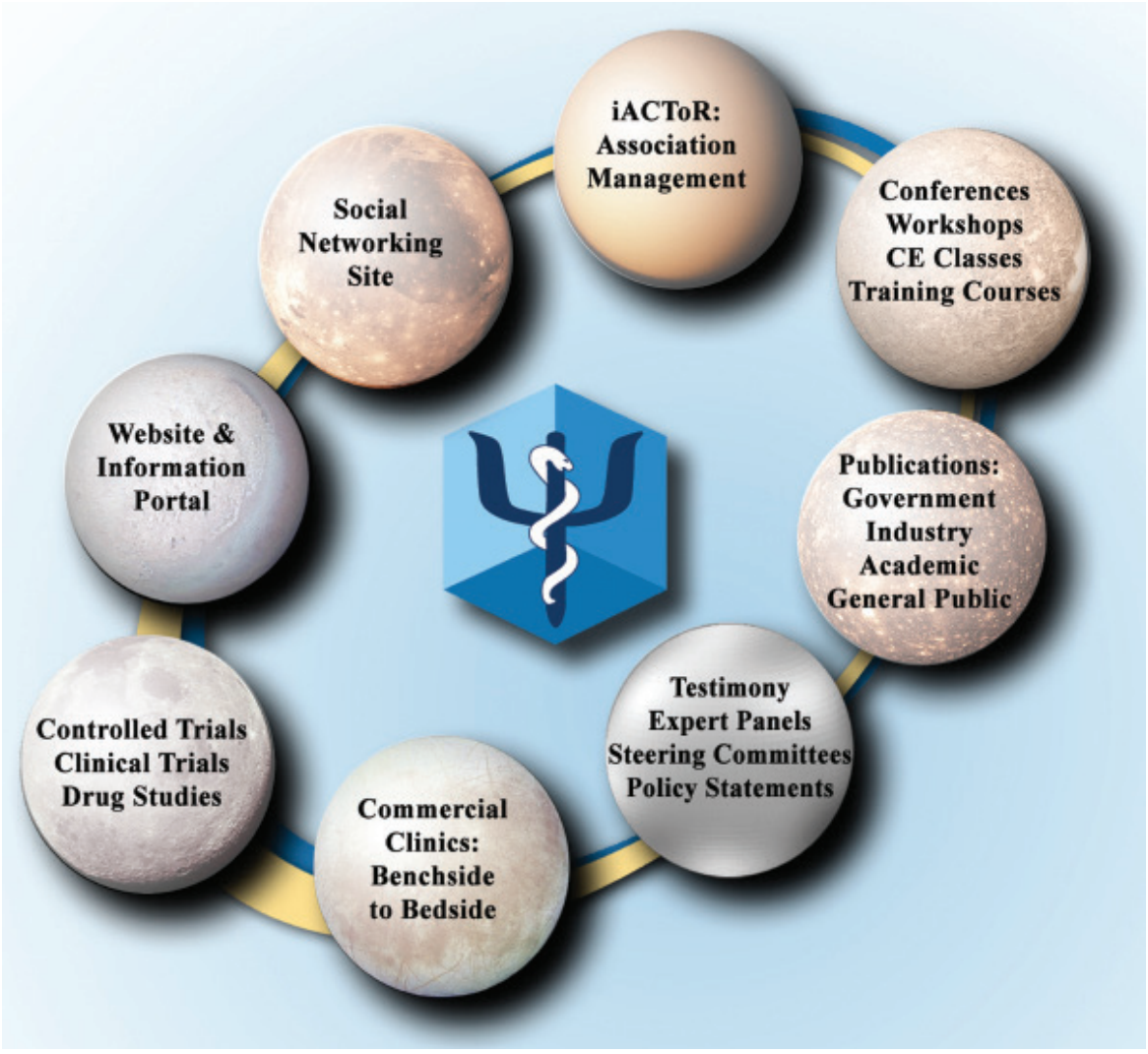

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Letter from the Secretary General and Editor-in-Chief

Professor Dr. Brenda K. Wiederhold

Will the EU Do a Better Job Than the U.S. in Funding Women and Small Businesses in Health Technology?

Last year, a grant-writer colleague reported that due to stiff competition, funding rates for U.S. National Institutes of Health (NIH) Small Business Innovation Research (SBIR) grants had declined for four straight years, from 2008 through 2011, with 2012 funded grants vs. applications expected to be in the single-digit percentages for the first time. Applications are up, absolute funding dollars are down as are the numbers of grants funded. And this was before the advent of sequestration, which brings even more trouble for SBIR funding. Although NIH SBIRs were cut less than Department of Defense SBIRs in 2013, funding was still down 2.7% to $697 million.

The European Union appears ready to outshine its rival across the pond when it comes to funding women and small and medium enterprises (SMEs) that invest in health technology. As noted in the interview with Neelie Kroes in this issue, the Digital Agenda for Europe supports research. Of interest in that document to our readers are:

• Key Action 9, which includes "'light and fast' access to EU research funds in ICT [Information and Communications Technology], making them more attractive notably to SMEs ...."

• Key Action 11, featuring "higher participation of young women and women returners in the ICT workforce through support for web-based training resources, game based eLearning and social networking."

Another guiding European Commission (EC) document referenced by Vice-President Kroes is the eHealth Action Plan 2012 – 2020, which outlines the vision for eHealth in Europe in line with the Digital Agenda and the Europe 2020 Strategy. Among the action plans are two of special interest:

• 5.2. Fostering the development of a competitive eHealth market, including EC support of "SME networking," "networking of European high technology incubators," and "actions to improve the market conditions for entrepreneurs developing products and services in the fields of eHealth and ICT for wellbeing."

• 6.2. Cohesion policy, featuring support of "ICT applications and services for citizens and SMEs," "integrated health and social care," and "eHealth for active and healthy ageing."
The health work program referenced by the Commissioner for Horizon 2020 is not yet finalized at the time this issue went to print, but a look at the preliminary priorities shows the EC "putting its money where its mouth is" in terms of actual funding available to SMEs, including one priority specifically targeted to SMEs:

• PHC 10 - 2014: Development of new diagnostic tools and technologies: in vitro devices, assays and platforms, and PHC 11 - 2015: Development of new diagnostic tools and technologies: in vivo medical imaging technologies - expected impact for these two priories includes "growth of the European diagnostics sector, in particular for SMEs."

• PHC 12 - 2014/2015: Clinical validation of biomarkers and/or diagnostic medical devices - this is the specific SME instrument with 100% funding, which "consists of three separate phases and a coaching and mentoring service for beneficiaries. Participants can apply to Phase 1 with a view to applying to Phase 2 at a later date, or directly to Phase 2." This is similar in structure to an NIH SBIR grant.

• PHC 32 - 2014: Advancing bioinformatics to meet biomedical and clinical needs - expected impact includes "Increased research and innovation opportunities in this SME-intensive field."

• PHC 33 - 2015: New approaches to improve predictive human safety testing - specifies that "Proposals should involve, amongst others, the research communities, SMEs, industry and regulatory agencies as appropriate ...."

While the eurozone continues to recover, growth may struggle to top 1% next year, according to economists. Therefore, we are grateful to the EC for its forward-thinking recognition that investment in technology-trained women and in SMEs pays off in accelerating the growth of nations.

Create your own reality!
Brenda Wiederhold

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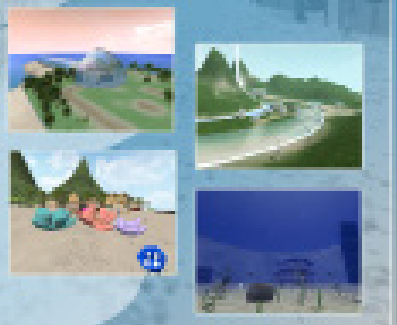

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- Emotional Balance
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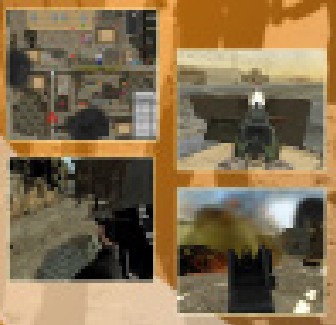

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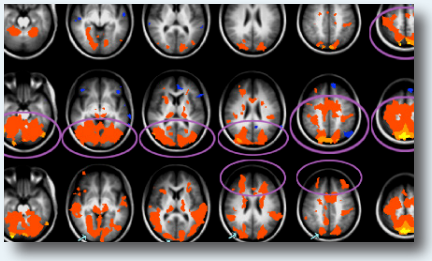

VR Combined with Advanced Brain Imaging: Understanding the Complexities Of Driving
ρ 25

To study the complex patterns of brain activity that support driving behavior, our team has recently developed an immersive driving simulator system with a fully operational steering wheel, brake pedal and accelerator that has been specially developed for use during functional magnetic resonance imaging (fMRI).

Virtual Rehabilitation: Beyond Gaming
ρ 20

Researchers are working on developing new solutions to bring further insights on how to improve the effectiveness of rehabilitation and improve quality of life of stroke survivors. In the context of motor rehabilitation, Virtual Reality (VR) has gained increased visibility in the last years. VR has become a very powerful tool for motor rehabilitation because it can be used to personalize rehabilitation to the needs of patients.

Highlights of the 18th Annual CyberPsychology, CyberTherapy & Social Networking Conference

By Tyler Walz

The 18th annual CyberPsychology, CyberTherapy & Social Networking Conference (CYPSY18) was held in Brussels, Belgium from June 30 – July 2, 2013. The conference, organized by the Interactive Media Institute in collaboration with the Virtual Reality Medical Institute, is the official conference of the International Association of Cyberpsychology, Training & Rehabilitation (iACToR). CYPSY18 participants included prominent academic, government and industrial representatives from 15 countries. iACToR's Secretary General, Professor Brenda K. Wiederhold, served as Conference Chair. CYPSY18's Scientific Committee was led by Professors Willem-Paul Brinkman, Jose Gutierrez Maldonado, and Giuseppe Riva, with Professor Stéphane Bouchard serving as Workshop Chair and Professor Pedro Gamito serving as Website Chair.

Preconference workshops included a wide array of topics including electronic health coaching, virtual reality for mental health, and the relationship between social networks and healthcare. The workshops were a great success and allowed for a lively exchange of ideas and research objectives.

CYPSY18's theme, Where Healthcare & Technology Connect, examined applications of advanced technologies being used in training, therapy, rehabilitation, and education for the improvement of the quality and availability of healthcare. Adding to this, attendees talked and shared valuable information about the influence of new technologies and how they impact behavior and society through the use of positive technology, healthy ageing and well being. The conference shed light on a fairly new phenomenon in the healthcare industry – the imprint of social networking and how these platforms shape individual behavior, interpersonal relationships, and society. The last concept discussed at the conference was the introduction of new technologies and new terms. CYPSY18 studied the psychological aspects of new areas influenced by technology, such as cyberstalking.

For the second year in a row the Director-General for DG CONNECT Robert Madelin gave the opening Keynote Address. He discussed "Cyber Everything in Horizon 2020", in which he described how the program will, in the near future, generate innovation, competitiveness and funding for top level research in the European Union.

The second Keynote Speaker was Richard M. Satava, Professor Emeritus of Surgery at the University of Washington, Seattle and this year's Lifetime Achievement Award recipient. Professor Satava spoke on "Advanced Technologies That Will Change Behaviors – Humanoid Robots, 3-D Printers, and Other Extraordinary Discoveries", a highly interesting talk on topics surrounding the future of progressive scientific and technological methods.

The first day concluded with a poster session and Cyberarium. This was an opportunity for scientists to share their ideas with each other and with interested spectators. This allowed developers and researchers to present their prototypes to policymakers, funding agents, and fellow researchers. This year, the EU-funded INTERSTRESS project and the Oculus Rift, an up and coming consumer-priced virtual reality headset, were among the most popular displays.

Two Ph.D. students were presented with the Young Minds Research Award; Fillipo La Paglia and Claudia Carissoli, who presented posters entitled "Neuropsychological Assessment through NeuroVirtual Reality in OCD Patients" and "Mindfulness and New Technologies: Creating and Testing a Brief Protocol to Reduce Stress", respectively. The New Investigator Award was given to Sungkun Cho for his work in "Body Swapping Training for Patients with CRPS Using a Virtual Body".

Those of us at the CyberTherapy & Rehabilitation Magazine would like to give a special thanks to members of the scientific committee and all participants who were key to the conference's success and were instrumental in generating feedback within the community. We would also like to sincerely thank the many institutions and organizations that sponsored and supported the event: European Commission, eHealth Week, Hanyang University Institute of Aging Society, International Association of CyberPsychology, Training, & Rehabilitation (iACToR), Interactive Media Institute, INTERSTRESS, ISfTeH, Istituto Auxologico Italiano, Mary Ann Libert, Inc. Publishers, National Institute on Drug Abuse, Universite du Quebec en Outaouais, Virtual Reality Medical Center (VRMC) and the Virtual Reality Medical Institute (VRMI). Finally, a very warm thanks to CYPSY18's coordinator, Chelsie Boyd.

Highlights of the
18th Annual CyberPsychology, CyberTherapy & Social Networking Conference

DG Robert Madelin gives a rousing Keynote Speech

Brenda Wiederhold with CYPSY18's Keynote Speakers

A participant using the Oculus Rift during the Cyber-arium

Participants networking during a break

Lifetime Achievement recipient Prof. Richard Satava presents his keynote speech

CYPSY18 attendees during a symposium

Conference Participation Report 2013

Belgian Economic Mission to the United States

California, USA
2-9 June 2013

The Virtual Reality Medical Institute (VRMI), represented by C&R's Editor-in-Chief Professor Brenda Wiederhold, was selected to participate in the recent Belgian Economic Mission to the United States, organized by the Belgian Foreign Trade Agency in collaboration with three regional institutions: Wallonia Foreign Trade & Investment Agency, Brussels Invest & Export and Flanders Investment & Trade and FPS Foreign Affairs. The event was presided over by Prince Philippe of Belgium and consisted of 393 participants, bringing together companies from various business sectors to expand their influence to the U.S. and promote trade between Belgium and the U.S.

European Health Forum Gastein (EHFG)

Gastein, Austria / **www.ehfg.org**
1-3 October 2013

The 15th Annual European Health Forum Gastein attracted 600 leading experts who continued to make decisive contributions to the development of guidelines and facilitated a cross-border exchange of experience, information and cooperation. The overall aim of EHFG f discussion for the various stakeholders in the field of public health and healthcare.

iACToR president Professor Brenda Wiederhold presented on behalf of the INTERSTRESS project. The unparalleled mix of participants including leading country- and EU-level representatives from the areas of health policy, administration, science, business and patient organisations, helped to create a framework for advising and developing European health policy.

ICT 2013

Vilnius, Lithuania
www.ec.europa.eu/digital-agenda/en/ict-2013
6-8 November 2013

ICT 2013 brought together Europe's best and brightest in ICT research, with businesses old and new, web start-ups and digital strategists to chart a path for Europe's ICT research policy. The conference was opened by the President of Lithuania, Dalia Grybauskait, who encouraged young people from all over Europe to consider a career in ICT. Neelie Kroes, European Commission Vice President for the Digital Agenda also spoke at the ICT2013 conference. In addition, members of the INTERSTRESS consortium, Giuseppe Riva, Andrea Gaggioli and Brenda Wiederhold, demonstrated their mobile application for reducing stress.

ICT 2013 was the first opportunity to learn the details of research funding for ICT-related projects under Horizon 2020, the EU's new research program for 2014-2020. The European Commission proposed an € 80 billion package for research & innovation funding, as part of the drive to create sustainable growth and new jobs in Europe.

INTERSTRESS Workshop: Stress Effects in Transportation

Thessaloniki, Greece / **www.certh.gr**
3 October 2013

CERTH (Centre for Research & Technology, Hellas) hosted a workshop entirely dedicated to the European funded INTERSTRESS project. The vision of the project is a personalized, immersive e-therapy in which biosensors, virtual reality simulations and presence allow for the ability to detect and manage stress anytime, anywhere. The event was oriented towards the rising interest from potential stakeholders (organizations/companies operating in the transportation business).

fMRI-VR:
Gateway to Complex Brain Processes

"Whatever the mind can conceive, it can achieve." - *Napoleon Hill*

By Mark D. Wiederhold & Brenda K. Wiederhold

Over the last decade the use of functional magnetic resonance imaging, or fMRI, has become an increasingly popular tool among researchers, who continue to be amazed at findings reinforcing the brain's neuroplasticity, its ability to adapt by forming new pathways and synapses. For psychologists, it has yielded new insight into the investigation of navigation, pain, anxiety, and cue exposure, and in suggesting ways to improve rehabilitation after brain injury.

What is fMRI?

MRI uses a powerful magnetic field, radio frequency pulses, and a computer to produce detailed pictures of organs, soft tissues, bone, and virtually all other internal body structures. Detailed images allow physicians to evaluate various parts of the body and determine the presence of certain diseases. Functional magnetic resonance imaging is a relatively new procedure that uses MR imaging to measure the tiny metabolic changes that take place in an active part of the brain. It has traditionally been used as a diagnostic tool for physicians to examine the anatomy of the brain such as assessing the effects of stroke, trauma, or degenerative disease (such as Alzheimer's) on brain function as well as to monitor the growth and function of brain tumors.

When a brain area is more active it consumes more oxygen, and to meet this increased demand blood flow increases to the active area. fMRI can be used to produce activation maps showing which parts of the brain are involved in a particular mental process. These are indications that a particular part of the brain is processing information and giving commands to the body. As a patient performs a particular task, the metabolism will increase in the brain area responsible for that task, changing the signal in the MRI image. So by performing specific tasks that correspond to different functions, scientists can locate the part of the brain that governs that function.

fMRI in Psychology Research

"fMRI can be used to produce activation maps showing which parts of the brain are involved in a particular mental process."

There have been several reasons for the increased use of this new tool in psychology research. First, the improvement in fMRI technique during the last decade has made fMRI data more precise and reliable. Second, it is noninvasive, relatively safe, and user-friendly in comparison to other neuroimaging tools. Third, fMRI allows for the continuous collection of data, which is useful for research purposes that require the tracking of ongoing processes.

The need for objective measures within the field has increased its popularity among researchers. Compared to the traditional questionnaire methods of psychological evaluation, fMRI is far less biased.

Virtual Reality Research and fMRI

One area of research currently being investigated is using fMRI to evaluate the effectiveness of virtual reality (VR) techniques to improve current VR systems that aid in creating more effective treatments for patients. Previous studies have consistently shown that the combination of VR with traditional therapies results in more successful outcomes for patients with a wide range of diagnoses. The most common measures used today to determine the effectiveness of VR therapies are self-report, simple cognitive testing, and physiological measurements including skin conductance, peripheral skin temperature, respiration rate, and heart rate.

Some of our early work showed that peripheral physiology did not always correlate with brain activity. We saw examples during VR therapy where signs of physiological arousal were desynchronous in the neural correlates and observed

peripheral physiological levels, indicating that some patients manifested peripheral arousal while others exhibited central arousal. These different arousal patterns are helpful in planning the therapeutic approach for these patients. We also noted distinct patterns of EEG waves which suggest differences in the perception of realness when patients are exposed to a virtual environment.

Early work by Pine and colleagues used fMRI to map brain regions engaged during memory-guided navigation in a VR environment in adolescents and adults. By 2004, Hoffman and colleagues had demonstrated direct modulation of human brain pain responses by VR distraction. Another early study by Lee and colleagues evaluated cue induced smoking cravings, concluding from fMRI-highlighted areas of the brain that virtual environments were more immersive and evoked smoking craving more effectively than traditionally used methods. An unexpected finding in this study showed that even when patients are motionless in the MRI experience, virtual walking can activate the cerebellar motor cortex.

By combining treatment with imaging of the brain itself, not only can the severity of the disorder be evaluated, and the treatment adjusted accordingly, but also outcomes may be improved through the creation of VR scenarios tailored to how the brain responds to stimuli. Use of brain imaging with VR provides an opportunity to see what is actually occurring in the brain before, during, and after treatment in a way that has never been possible in the past and which can help to create more effective and appropriate treatments in the future. An update to a 2008 report on fMRI-VR studies is contained in the table that follows.

Author	*Point of interest*	*Title*	*Publication*
Navigation and Spatial Processing			
Beck, Wolter, Mungard, Vohn, Staedtgen, Kuhlen, Sturm	Differences in brain processing between VR and the real world have to be taken into account when designing VR therapy tools and measuring their effect on recovery	Evaluation of spatial processing in virtual reality using functional magnetic resonance imaging (fMRI)	Cyberpsychol Behav Soc Netw 2010; 13(2):211 – 215
Weniger, Ruhleder, Lange, Wolf, Irle	Suggests that specific VR tasks could be designed to predict conversion from mild cognitive impairment to dementia	Egocentric and allocentric memory as assessed by virtual reality in individuals with amnestic mild cognitive impairment	Neuropsychologia. 2011; 49(3):518 – 527
Hung, Vetivelu, Hird, Yan, Tam, Graham, et al.	Cerebellum-damaged drivers drove more slowly than controls, yet functional compensation (neuroplasticity) preserved their driving ability	Using fMRI virtual-reality technology to predict driving ability after brain damage: A preliminary report	Neurosci Lett 2014; 558:41 – 46
Pain Distraction			
Hoffman, Richards, Bills, Van Ooostrom, Magula, Weibel, Sharar	Large drops in subjective pain ratings during VR are accompanied by large drops in pain-related brain activity	Using fMRI to study the neural correlates of virtual reality analgesia	CNS Spectr 2006; 11(1):45 – 51
Hoffman, Richards, Van Oostrom, Coda, Jensen, Blough, Sharar	Patterns of pain-related brain activity support the significant subjective analgesic effects of VR distraction when used as an adjunct to opioid analgesia	The analgesic effects of opioids and immersive virtual reality distraction; evidence from subjective and functional brain imaging assessments	Anesth Analg 2007; 105(6):1776 – 1783
Anxiety, Fear, PTSD			
Andreano, Liang, Kong, Hubbard, Wiederhold BK, Wiederhold MD	As an experience becomes more immersive, additional brain areas related to memory are activated	Auditory cues increase the hippocampal response to unimodal virtual reality	Cyberpsychol Behav 2009; 12(3):309 – 313
Roy, Francis, Friedlander, Banks-Williams, Lande, et al.	Clinical Global Impression scores and scans indicated significant improvement in PTSD from both VR therapy and imaginal exposure, PTSD Scale score improvements were not significant	Improvement in cerebral function with treatment of post-traumatic stress disorder	Ann N Y Acad Sci 2010; 1208:142 – 149
Alvarez, Chen, Bodurka, Kaplan, Grillon	Only unpredictable threats activated brain structures associated with emotions and stress	Phasic and sustained fear in humans elicits distinct patterns of brain activity	Neuroimage 2011; 55(1):389 – 400
Schweizer, Kan, Hung, Tam, Nagile, & Graham	During distracted driving, brain activation shifted dramatically from the posterior, visual and spatial areas to the prefrontal cortex	Brain activity during driving with distraction: an immersive fMRI study	Front Hum Neurosci 2013;7(53):1-11.

Author	*Point of interest*	*Title*	*Publication*
Rehabilitation Studies			
Saleh, Bagce, Qiu, Fluet, Merians, Adamovich, tunik	Piloted a way to study neural plasticity by tracking finger movement during a motor task in the scanner and giving online visual feedback	Mechanisms of neural reorganization in chronic stroke subjects after virtual reality training	Conf Proc IEEE Eng Med Biol Soc 2011; 2011:8118 – 8121
Hanten, Cook, Orsten, Chapman, Li, Wilde, et al.	Results suggest an integrated approach in both behavioral analysis and neuroimaging to delineate specific mechanisms relating to social problem solving and decision making	Effects of traumatic brain injury on a virtual reality social problem solving task and relations to cortical thickness in adolescence	Neuropsychologia 2011; 49(3):486 – 497
Nocchi, Gazzellini, Grisolia, Petrarca, Cannatà, Canna, et al.	Showed that processing of non-biological movements relies on the same structures as those involved in biological motion processing	Brain network involved in visual processing of movement stimuli used in upper limb robotic training: An fMRI study	J Neuroeng Rehabil 2012; 9:49
Prochnow, Bermúdez i Badia, Schmidt, Duff, Brunheim, et al.	Supports the hypothesis that this novel neurorehabilitation approach engages human mirror mechanisms that can be employed for visuomotor training	A functional magnetic resonance imaging study of visuomotor processing in a virtual reality-based paradigm: Rehabilitation Gaming System	Eur J Neurosci 2013; 37(9):1441 – 1447
Orihuela-Espina, Fernández del Castillo, Palafox, Pasaye, Sánchez-Villavicencio, et al.	The relation between behavioral and brain changes suggests that those with stronger impairment benefit the most from this paradigm	Neural reorganization accompanying upper limb motor rehabilitation from stroke with virtual reality-based gesture therapy	Top Stroke Rehabil 2013; 20(3):197 – 209
Tunik, Saleh, Adamovich	Data suggest that manipulation of visual feedback of one's own hand movement may be used to facilitate activity in select brain networks and aid in recovery during VR training	Visuomotor discordance during visually-guided hand movement in Virtual Reality modulates sensorimotor cortical activity in healthy and hemiparetic subjects	IEEE Trans Neural Syst Rehabil Eng 2013; 21(2): 198 – 207
Alcohol and Smoking Studies			
Moon, Lee	Virtual-environment cue exposure appears to be an effective method of treating nicotine craving	Cue exposure treatment in a virtual environment to reduce nicotine craving: A functional MRI study	Cyberpsychol Behav 2009; 12(1):43 – 45.
Lee, Lim, Wiederhold, Graham	Virtual-environment cue exposure activates brain regions more effectively than 2D smoking cues	A Functional Magnetic Resonance Imaging (fMRI) Study of Cue-Induced Smoking Craving in Virtual Environments	Applied Psychophysiology and Biofeedback 2005; 30(3):195-204

To improve responses to anxiety, one study by Andreano and colleagues (see table) evaluated neural activity using fMRI during exposure to two different virtual worlds. Research has suggested that the effectiveness of VR exposure therapy should increase as the experience becomes more immersive. Two levels of immersion were used: unimodal (video only) and multimodal (video plus audio). In addition to increased activity in both auditory and visual sensory cortices, multimodal presentation elicited increased activity in the hippocampus, a region well known to be involved in learning and memory. This suggests that VR exposure therapy for conditions such as PTSD would be most effective with VR worlds that increase presence and immersion and allow for effective learning to occur, reducing the association between the cue and the maladaptive emotion. It is evident that multimodal stimulation during fMRI presents an extremely valuable tool for the study of how the brain perceives virtual spaces and activities. The ability to present nearly any type of situation or challenge will allow the collecting of MRI data that would not otherwise be possible. In Blascovich and Bailenson's excellent book, "Infinite Reality", they underline the importance of presence and immersion in guiding VR development and applications.

Much work is being doing using fMRI-informed VR for rehabilitation. In research by Pruchnow and colleagues (see table), fMRI has been used to evaluate a specific VR treatment known as the Rehabilitation Gaming System (RGS). RGS is a VR tool for the rehabilitation of deficits that occur

"By combining treatment with imaging of the brain itself…outcomes may be improved through the creation of VR scenarios tailored to how the brain responds to stimuli."

after brain lesions and has been successfully applied to the rehabilitation of the upper extremities after stroke. One study that evaluated its effectiveness using fMRI concluded that the researchers had preliminary support for the hypothesis that RGS engaged human mirror mechanisms employed for visuomotor training, an important component of this type of rehabilitation.

Limitations

There are clear advantages to using the fMRI technique within this field of research. Verbal reports can be distorted or biased, and fMRI offers a more objective tool. fMRI is appealing because it can be used to investigate psychological operations. However, while these phenomena can certainly be informed by fMRI data, it is not always clear how the results are to be interpreted. fMRI is unable to determine the activities of individual neurons, which are critical to mental function. Each area of the brain studied in fMRI is made up of thousands of individual neurons, each of which might have a unique story to tell. Because certain areas of the brain that "light up" on fMRI may represent a number of different functions, it's hard to identify exactly what kind of brain activity is being represented on the scan.

Another barrier is the cost of scans, which effectively limits the research sample size. It can cost more than $1,000 to run an individual study participant through the scanner. However, larger sample sizes are not always necessary. fMRI collects measures of activation from all over the brain; therefore, the sample size is much larger than the number of subjects. Additionally, there is much less variability between subjects' brain activity than between behaviors, and therefore fewer confounding variables. Provided psychologists take such concerns seriously, and exercise caution when using fMRI, functional neuroimaging should prove a useful research tool.

Future

While there are some limitations to fMRI, its advantages are clear. Over the past several years we have been working with Better Day Software, Shanghai Normal University, and Shanghai Key Laboratory to further develop more affordable MRI-safe display technologies that will further enhance our ability to treat mental health disorders and investigate the brain's reaction to these treatments. Our work, which has been supported by the National Institute on Drug Abuse, National Institutes of Health, will continue to search for underlying brain mechanisms important for the identification of potential therapeutic targets. New technologies and techniques are being investigated that will improve its accuracy by focusing on individual neurons. The belief is that by recording the electrical activity in neurons, a more complete and precise picture of brain activity will be achieved. In sum, the increased use of fMRI research for the investigation of psychological questions, in particular VR therapy, has been a cause for celebrating the ability of the mind to conceive … and achieve.

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fNIRS in Virtual Environments: A New Tool for Neurocognitive Rehabilitation

"Virtual Reality (VR) ...has reached a considerable value in medical, psychological, and neuropsychological treatments as it can be used for rehabilitating a broad variety of clinical populations ..."

By Simone Cutini et al.

Figure 1: Setup of fNIRS (Functional Near Infrared Spectroscopy) and VR (Virtual Reality)

Virtual Reality (VR) is a useful tool in several fields and has reached a considerable value in medical, psychological, and neuropsychological treatments as it can be used for rehabilitating a broad variety of clinical populations, such as stroke patients (to recover gait or arm movements) or patients suffering from mental disorders (e.g. phobia or post-traumatic stress disorder). Indeed, several studies have shown that the same brain regions involved in these tasks in real life are also activated in the VR environment by mimicking the same task. In order to adjust and optimize the specific therapy required by each patient, it is mandatory to the improvements accomplished by the patient during his/her treatment. Qualitative data obtained through questionnaires and self-reported measures, as well as quantitative data registered during the interaction of the participant with the virtual environment can be easily collected.

However, they do not provide sufficient information: for instance, questionnaires do not inform how and where the neural recovery is taking place, and whether the improvement is temporary or permanent. A proper therapy should provide a permanent modification of the brain (thanks to its plasticity); thus, it is important to deeply understand the cerebral modification caused by rehabilitation techniques.

" ... studies have shown that the same brain regions involved in these tasks in real life are also activated in the VR environment by mimicking the same task."

Brain imaging methods are the main tools that can provide such information. Despite their widespread use, functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) present many disadvantages. Indeed, the bulky device, the loud noise, the horizontal and unnatural position of the participant, who is required to stay still for the former and the invasive use of radioactive tracers for the latter, are limiting factors for their use in a context of rehabilitation, even in a VR environment. The ideal brain imaging technique should be silent, should permit free movements of participants and should be non-invasive. Functional near-infrared spectroscopy (fNIRS) is a novel neuroimaging technique, which encompasses these features. It exploits the properties of light in the near-infrared range to detect cerebral activity. It is completely non invasive, less sensitive to motion artifacts and able to measure different cerebral parameters, which allow monitoring the modification of the brain regions during therapy.

Owing to recent advantages in the hardware development, wireless fNIRS devices have been recently proposed. The absence of cables makes these new devices even less sensitive to motion artifacts and allows the participant more freedom in his/her movements. The patient immersed in the virtual reality can easily move the body while performing the required tasks in the VR environment. This information is very important for physicians: fNIRS permits monitoring the brain during the therapy, while the patient is performing the exact task required during the rehabilitation session. Moreover, wireless fNIRS devices are so small that they can be carried like a bag. Children will obviously benefit from this feature, which, coupled with the virtual reality environment, can render the rehabilitation therapy less stressful and more comfortable. Encouragingly, the first studies combining fNIRS and VR provided positive results, making clear the capability of fNIRS to measure the cerebral signal while participants are moving in a virtual reality environment. In a recent study, we have shown that fNIRS is able to detect brain activity in the parieto-occipital region by participants wearing VR goggles during a line bisection task in an immersive VR environment; another investigation has shown that an interactive VR environment can properly elicit cortical oxygenation changes related to action observation. Another fNIRS study has investigated the prefrontal cortex response to virtual reality tasks that might be easily adopted in the field of functional neurorehabilitation. The participants were required to carry out an incremental and a control swing balance task in a semi-immersive VR environment, i.e. to try to maintain equilibrium on a virtual swing board susceptible to external perturbations (of different strengths in the former and of constant strength in the latter). Crucially, the authors found an increase in prefrontal cortex activity whilst carrying out the first task, thus highlighting the usefulness of fNIRS in these scenarios.

The combination of fNIRS and virtual reality is in its early days but it is clear how new hardware and software developments (e.g. improvements in signal processing techniques, in the hardware of the devices, in the virtual reality environment, etc.) will foster the use of fNIRS and VR for rehabilitation purposes. In conclusion, fNIRS is the neuroimaging technique that can provide the greatest flexibility, freedom of movements and comfort to the patients in a VR rehabilitation setting; at the same time, it can provide therapists valuable information for an optimal planning of the therapy.

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The Impact of Anthropomorphic Realism of Virtual Humans on Human Experience:

A Growing Field of Research

"Virtual reality provides a sophisticated approach to facilitating intervention in psychotherapy by bringing aspects of the real world and its complexities to 'virtual' life."

By Marcus Cheetham

Virtual reality provides a sophisticated approach to facilitating intervention in psychotherapy by bringing aspects of the real world and its complexities to 'virtual' life. An increasingly important part of this approach involves the use of avatars (i.e. computer-generated characters). The anthropomorphic realism of avatar appearance and (interactive) behaviours is advancing steadily. Even with the success of virtual-reality based interventions, an understanding of the impact of advances in anthropomorphic realism on human experience is important because this is likely to contribute to optimising the effectiveness of an intervention. An important question is how humanlike does an avatar, or virtual human, need to be to optimally evoke and sustain the patient's attention, behaviour and experience in a way consistent with the aim of the intervention?

Comparatively little research has been conducted into the specific influence of high anthropomorphic realism of virtual humans on human experience. One point of concern that is currently receiving the attention of researchers is expressed in the Uncanny Valley Hypothesis. The hypothesis posits that highly realistic virtual humans might have a negative impact on affective experience (i.e. a disquieting or uncanny effect) when the virtual human is sufficiently realistic that a person is not quite sure whether it is actually human or nonhuman. One focus of recent research has been to examine therefore how affective experience is influenced by the anthropomorphic realism of virtual humans. Research of this kind is still in its infancy, and the initial findings are not yet conclusive. More research needs to be conducted to determine when and under what conditions such high levels of anthropomorphic realism might negatively impact subjective experience.

Figure 1. Example of a highly realistic virtual human

Another focus of recent research has been to develop a more in-depth understanding of whether and in what way individuals use different sensory information and cognitive processing strategies to perceive and recognise virtual humans than they use to process their human counterparts. One important consideration is that individuals usually have extensive everyday experience processing faces of the human category and processing perceptual differences between human faces but comparatively little experience of this kind with virtual humans. In one study, Cheetham, Suter and Jancke used fMRI and a paradigm designed to isolate neural processes that specifically respond to a change in category between human and highly realistic avatar faces (Figure 1). The findings show that a different pattern of brain structures responds to

faces of the human compared with the virtual human category. Importantly, these structures are known to respond differently depending on the degree of categorisation experience with a given category. Motivated by this fMRI study, subsequent studies using other methods of investigation support this, indicating that perceptual and categorisation knowledge and experience influences the use of different perceptual and cognitive strategies to distinguish between and recognise virtual human faces compared with human faces.

Research of this kind is still in its infancy. But it is likely to contribute to understanding how greater and, under circumstances, lesser humanlike realism (e.g. more stylised virtual humans) might be best utilised to influence human experience and behaviour in a way that is consistent with the aims of an intervention or of other applications. Given the pace of progress in computer-graphics technologies in developing more realistic and intelligent interactive virtual humans and the advance of these technologies into a diversity of traditional human activities such as psychotherapy, learning and education, marketing and communication, it is likely that research into the effects of humanlike realism on human experience will intensify and contribute to the effective use of virtual humans in a range of applications.

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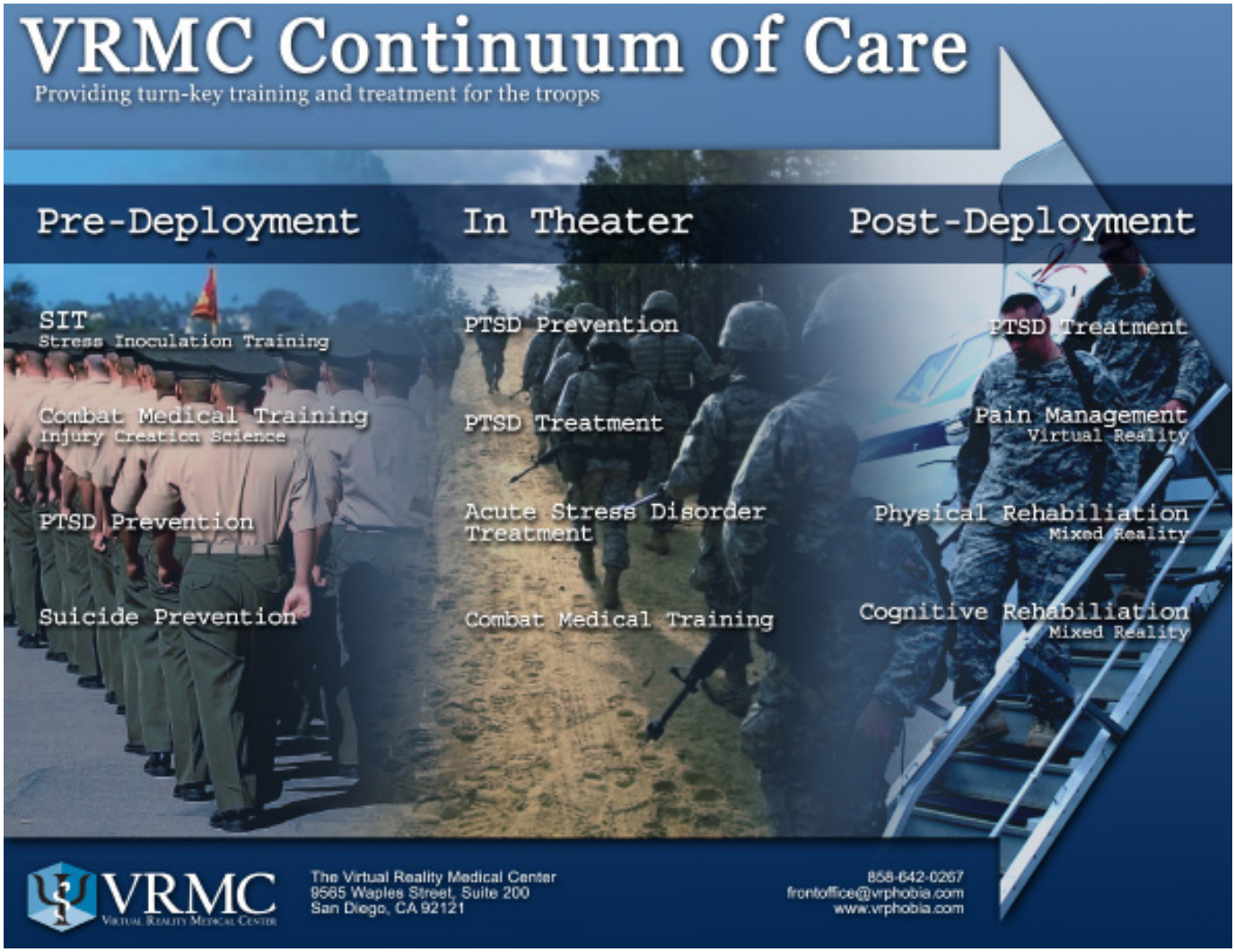

Virtual Rehabilitation
Beyond Gaming

"VR allows altering feedback and enabling users with disabilities to interact with virtual environments in a way that would not be possible in the real world."

By Sergi Bermúdez i Badia

Every year millions of people suffer a stroke worldwide, and about one third presents chronic motor impairments. The social and economical cost of stroke is becoming unsustainable, and already represents 2-4% of total healthcare costs worldwide. In the context of motor rehabilitation, Virtual Reality (VR) has gained increased visibility in the last few years. VR has become a very powerful tool for motor rehabilitation because it can be used to personalize rehabilitation to the needs of patients. VR allows altering feedback and enabling users with disabilities to interact with virtual environments in a way that would not be possible in the real world. However, VR motor rehabilitation paradigms should not be the mere computerization or gamification of traditional praxis. Instead, VR training needs to incorporate neuroscientific hypotheses in order to maximize brain plasticity mechanisms responsible for recovery.

VR can be used to provide more direct interventions at the central nervous system level by closing the sense-act loop in a controlled manner, and restoring sensorymotor contingencies compromised by stroke. In this way, VR can provide cues for reward and error correction essential for motor adaptation, error feedback and sensorimotor integration networks. Similarly, it enables motor impaired patients to generate meaningful goal oriented motor actions to recruit the neural networks responsible for action recognition, the mirror neurons. In a previous study Cameirão et al. have shown that VR training paradigms that embrace clinical and neuroscientific guidelines lead to improved motor function in stroke patients compared to traditional physical and occupational therapy.

In two recent studies, we have coupled VR motor rehabilitation training and brain imaging technologies – electroencephalography and functional Magnetic Resonance Imaging (fMRI) – to recreate a VR training paradigm with healthy participants in controlled settings. Both studies have shown consistent results pointing towards an increased effectiveness of paradigms based on motor imagery in recruiting motor related brain networks. In particular, the fMRI study by Prochnow et al. has revealed activation in brain regions associated with motor control consistent with those related to the human mirror neuron system. Although these are important findings, at this moment we are still far from fully understanding what the effective ingredients of VR rehabilitation systems are, and what the best way of personalizing rehabilitation protocols in terms of system type, method and dose is. The consequence is that despite numerous technological advantages provided by VR systems we cannot take full advantage of them. Hence, there is an urgent need to continue coupling VR rehabilitation systems with brain imaging technologies to further understand how neuroanatomical determinants, such as lesion size and location, affect motor execution; how the corresponding brain mechanisms underlie recovery; and how to provide optimal rehabilitation strategies for each individual case.

Figure 1: A stroke patient using the Neurorehabilitation Training Toolkit (NTT), a VR upper limb motor rehabilitation system for training bimanual coordination.

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fMRI as a Breakthrough

Studying Effects of Virtual Reality on Brain Activity

"With the newfound ability to map brain functionality using MR technology in real time, it became possible to connect people's subjective thoughts and emotions with an objective understanding of brain activity."

By Kenneth Gao et al.

Since the introduction of functional magnetic resonance imaging (fMRI) over two decades ago, MRI research and demand have boomed. With the newfound ability to map brain functionality using MR technology in real time, it became possible to connect people's subjective thoughts and emotions with an objective understanding of brain activity. fMRI has since found a home in a variety of clinical and research areas, from drug addiction and alcohol and smoking cessation to stroke and brain injury. In 2010, the global MRI market was valued at $5.5 billion and is expected to grow to $7.5 billion by 2015. Researchers around the world are exploring methods of improving fMRI functionality and exploring other areas of application of this powerful technology.

"fMRI technology now opens up new possibilities to understand how this illusion of presence in a virtual environment causes changes in the brain."

One of the prominent uses of fMRI has been to study the effects on brain activity of virtual reality (VR), a technology that has had recent utilization in a wide variety of clinical settings. fMRI technology now opens up new possibilities to understand how this illusion of presence in a virtual environment causes changes in the brain. However, there have been many obstacles barring this application. An immersive virtual reality system requires a series of equipment and environmental constraints that an fMRI magnet bore typically cannot accommodate. Effective immersion usually requires head-tracking sensors, a head-mounted display, a surround sound system, and an input device to navigate the environment. When one imagines an MRI scanner, it is easy to see where its physical constraints prevent the use of such equipment. During an MRI scan, patients are lying inside a magnet tube, unable to move their head, frequently distracted by the claustrophobic environment. Without the feeling of presence and immersion into the virtual environment, researchers are finding it difficult to utilize fMRI technology to study the effects of virtual reality.

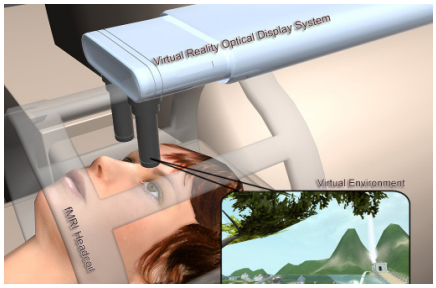

Figure 1: VR compatible MRI scanner with subject looking into VR goggles

One of the first attempts to study changes in mental activities from the use of VR occurred at the University of Washington. To overcome the physical constraints of a MRI scanner, the team of researchers developed a custom display that fits into the MR head coil, capable of projecting wide field-of-view images using nonconductive and nonferrous materials (Figure 1). They guided seven subjects through a virtual snowy environment while placed in an MRI scanner. Each subject reported experiencing strong illusion of presence despite lying down in an enclosed environment.

Moreover, the research team successfully acquired brain scan images that were not obstructed by the VR image

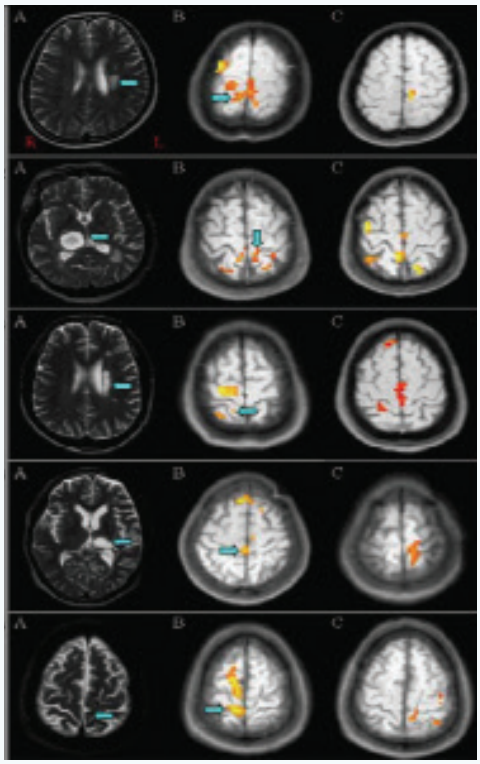

Figure 2: MRI scans of five patients. A: diagnostic MRI images, B: before VR, showing ipsilateral activations, C: after VR, showing decreased ipsilateral activations

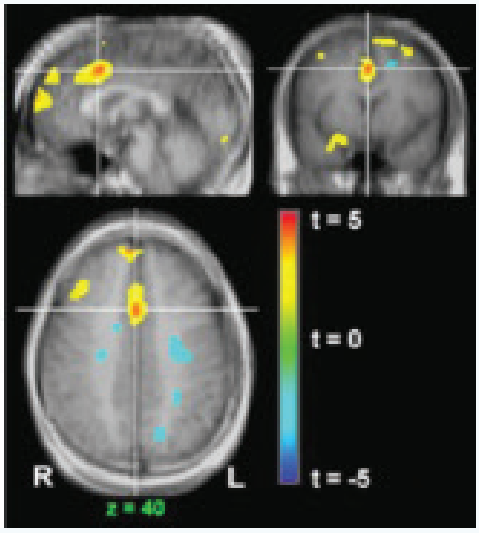

Figure 3a: Response to 2D environment with activation of anterior cingulate gyrus

system, demonstrating the capability of visually analyzing effects of virtual reality on brain activity.

VR has seen interesting applications in areas such as stroke rehabilitation. Stroke patients may experience weakness or paralysis of limbs and must undergo physical rehabilitation to regain control. VR has been proven to be an interactive and enjoyable intervention method to improve upper extremity motor function, however, the neural mechanisms supporting its use has only been recently investigated. Following the development of fMRI compatible VR delivery systems, researchers from Yeungham University and Sungkyunkwan University in Korea and Hampton University in the United States conducted an experimenter-blind randomized study of ten chronic stroke patients that resulted in interesting brain activity pre- and post-VR. Among the movements of brain activity, the study found that cortical activation was reorganized before VR, from ipsilateral activation, and after VR, to contralateral activation (Figure 2). Overall, it was shown that VR contributed to positive changes in neural organization and was one of the pioneering studies that explored the effectiveness of VR in neurorehabilitations.

Another prominent area of virtual reality and neuroscience research is that of smoking craving. To combat the effects of nicotine, many smoking cessation programs use cue exposure therapy, a method that bombards patients with common smoking-related cues to desensitize their urge to smoke. Despite extensive behavioral studies on cue effects, few have explored its effects on brain activity. Jang-Han Lee et. al. utilized fMRI to conduct a pilot study to test whether smokers could experience response to smoking cues during an MR scan and investigated the corresponding activity in the brain. He confirmed his hypothesis that smokers do experience greater craving as suggested by activation of the prefrontal cortex, anterior cingulate cortex, supplementary motor area, inferior temporal cortex, and the occipital lobe when smokers viewed cues in the 2D virtual environment (Figure 3a). Interestingly, the experiment showed that similar, but not all, regions were engaged in a 3D virtual environment (Figure 3b). In the 3D world, the prefrontal cortex and cerebellum were activated, presumably in response to the required attention and visual balance required in a 3D environment.

As interest quickly climbed in the world of virtual reality, the challenge of improv-

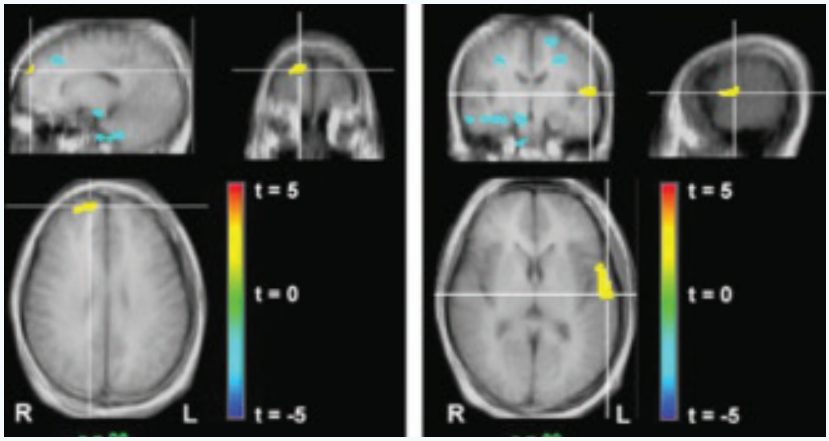

Figure 3b: Response to 3D environment with activation in right superior fontal and left superior temporal gyrus

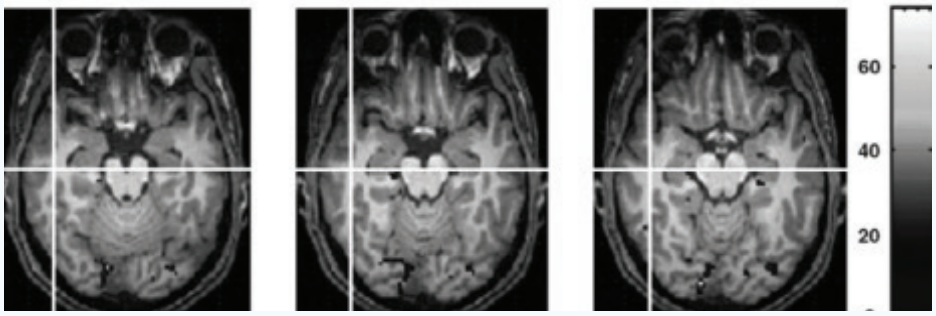

Figure 4: Activations of visual cortex and hippocampus in response to audio stimulation compared to presentation without.

ing its effectiveness arose. Research suggests that results of VR therapy improves as the VR experience becomes more immersive. To better understand the neural mechanisms behind this trend, Joseph Andreano et. al., conducted a study to explore one of the fundamental methods of altering immersion levels by comparing brain activity while using unimodal VR (only visual stimulation) and multimodal VR (with auditory and visual stimulation).

As expected, he found that there is substantial response to immersion in virtual environments as compared to rest, particularly in regions associated with visual and auditory stimulation such as primary visual and auditory cortices, fusiform cortex, and amygdala (Figure 4). More interestingly, results showed that in the multimodal environment, several brain regions not engaged in the unimodal VR were activated. The primary visual cortex, inferior temporal cortex, and part of the ventral visual stream, regions not associated with audition, were highlighted. Parietal somatosensory areas and bilaterial clusters in the hippocampus were engaged as well. These results seem to indicate that immersion in a virtual environment activates higher cognitive processes, particularly those related to memory.

At first, fMRI and virtual reality were incompatible. But the allure of the vast knowledge that could be gained has motivated researchers to bring these two worlds together. After it was shown that it is possible to successfully deliver immersive virtual worlds in an MRI scan, fMRI and VR have gone hand-in-hand. Previous applications of VR in therapy and rehabilitation that were previously heavily studied in behavioral and psychological manners could now be explored from a neuroscience point of view. As more experiments are conducted on the subject, the elusive concepts behind the brain can be studied in a reliable, flexible, and experimental manner using virtual reality.

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Activating Motor Cortex by Means of Virtual Tools

" …action perception and action execution are intrinsically linked from the neuronal level."

By Cristián Modroño et al.

Mirror neurons were originally discovered by the neurophysiologist Giacomo Rizzolatti and his team using electrodes placed in motor regions of macaque monkey brains. These researchers found neurons that discharged not only when the monkeys performed a particular action (e.g., reaching for a piece of food) but also when they observed others (e.g., one experimenter) performing the same or a similar action. This was an important discovery for neuroscience, showing that action perception and action execution are intrinsically linked from the neuronal level.

Besides monkeys, much research has been performed on healthy humans, where for ethical reasons, indirect brain activity measurement techniques are used instead of placing electrodes inside the brain. Functional magnetic resonance imaging (fMRI), a technique which measures brain activity by detecting associated changes in blood flow, is one of the most commonly used techniques. Therefore, it is not common practice to talk about single mirror neurons in humans but rather the human mirror neuron system. Such a system is mainly comprised of motor regions of the brain cortex, and is also activated by both the perception and the execution of a specific action.

Figure 1: A participant playing the virtual game inside the MRI scanner

Figure 2: Different motor regions are activated by both playing and observing the virtual game

A major challenge for researchers is to understand what the mirror neuron system is for. It has been said to play a role in different aspects of the human capabilities, e.g., understanding the actions and intentions of others, imitation, language or empathy; however, its exact functions are still being debated. While basic neuroscience keeps on working to clarify these roles, the essential property of the mirror neurons (i.e., its activation by both executed and perceived actions) also has a clinical application in the field of neurorehabilitation based on action observation. This approach relies on the visual presentation of actions to increase the activity in the mirror neuron system, since this activity may facilitate the reorganization of the motor areas affected by stroke. Specifically, such treatments could be a good option to rehabilitate patients who cannot perform certain movements as a result of an accident.

In line with this research, we have developed an experimental virtual environment based on a paddle and ball game to be used inside an MRI scanner. The participants play the game in one experimental condition where they have to hit an approaching virtual ball back towards their opponent, using a virtual paddle that they control with broad movements of their hand. In the second experimental condition, the participants don't play: they are mere observers of the games. Their brain activity is scanned during the two conditions using fMRI. The results reveal that not only playing the virtual game but simply observing it produces extended activations in (motor) regions of the mirror neuron system. It is interesting to note that virtual tools can be used to produce mirror activity, as happens when watching videos of ac tors, which is the most frequent option in action observation experiments. In this sense, virtual reality offers several advantages, such as greater control over the presented scene or enabling interaction. The results provide new support for the hypothesis underlying the neurorehabilitation systems based on action observation and encourages further research and development of virtual environments that can be used for patients, even from their own home.

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Virtual Reality Combined with Advanced Brain Imaging:

Understanding the Complexities Of Driving

"...the essential role of intact cognition...needs to be better understood to make our roads safer.

By Tom A. Schweizer et al.

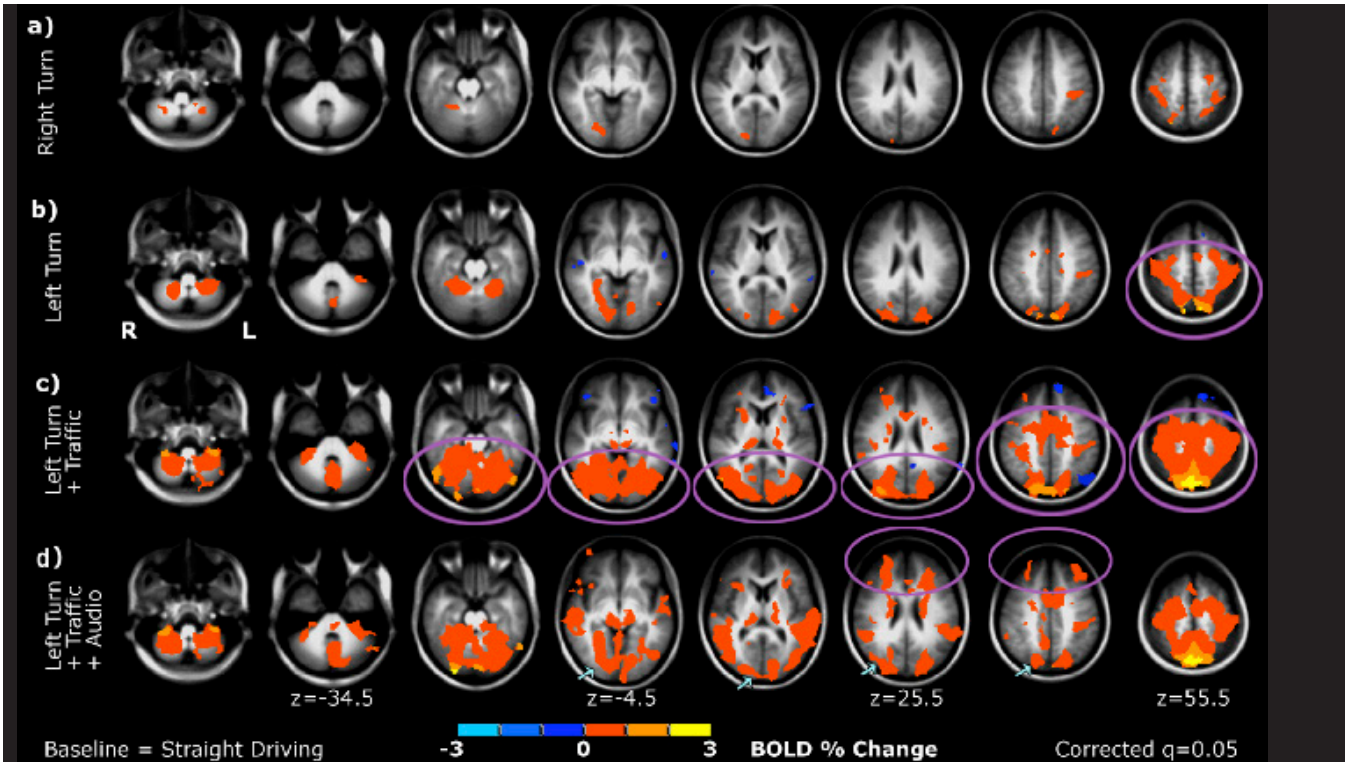

Figure 1: Relation between specific driving task and brain region activity using fMRI (Frontiers of Human Neuroscience)

Driving is an essential daily behavior for many people. For some, it provides freedom and easy travel. For others, driving is their livelihood. We often take the ability to drive for granted, but it is a very complex behavioral task that requires coordinated perceptual, cognitive, and motor functions. Impaired vision and motor function can negatively impact safe driving, and various assistive devices such as corrective lenses and altered driving controls are very successful solutions. However, the essential role of intact cognition - including, for example, the ability to sustain attention during a task, divide attention between multiple tasks when necessary while avoiding distractions, and to make sound driving judgements related to on-road conditions- needs to be better understood to make our roads safer.

The visual, motor and parietal cortices, as well as the cerebellum, are critical brain regions involved in driving competence and are responsible for visual-motor and visual-spatial processing and integration. Normal healthy aging and different types of neurological conditions can cause impairments of attention, memory and executive "frontal lobe" functions that are critical to driving ability. In today's world,

with the increased prevalence of smart phones and cars outfitted with high-tech communication devices, it is becoming increasingly important to understand how the brain deals with distractions during driving.

To study the complex patterns of brain activity that support driving behavior, our team has recently developed an immersive driving simulator system with a fully operational steering wheel, brake pedal and accelerator that has been specially developed for use during functional magnetic resonance imaging (fMRI). This advanced set-up provides a realistic, highly controlled, safe, confidential testing environment for studying simple as well as increasingly challenging driving scenarios, across the spectrum of healthy drivers and those with neurological or psychiatric disorders, in a manner that cannot be achieved safely during on-road testing.

In a recent study, we found that different aspects of driving performance relied on different brain regions. For example, when performing more straightforward driving manoeuvres such as driving straight or making right-hand turns, experienced young, healthy adult drivers were found to activate a network of brain regions related to visual-motor and visual-spatial coordination (see Figure 1). When these individuals performed more complicated manoeuvres,

"In a recent study, we found that different aspects of driving performance relied on different brain regions."

such as making a left turn at a busy intersection with oncoming traffic (where importantly, most fatal accidents occur), they activated more brain regions, and to a much larger spatial extent. Furthermore, when the same left-hand turns were made during a distracting auditory task, similar to talking on a hands-free cell-phone, a striking, potentially dangerous brain activation pattern emerged. During distracted driving, brain activity shifted from regions critical for visual processing, to frontal regions that play a role in divided attention and multitasking. This observation suggests that distracted driving has the potential to limit the neural resources that are available for driving safely.

Figure 2: fMRI and driving setup

What will be the long-term significance of this finding? Time will tell; we are in the process of conducting ongoing driving simulator and fMRI experiments in healthy young adults, elderly adults and patients suffering from stroke and Alzheimer's disease to investigate the impact of distractions on driving safety. Possible outcomes include assisting physicians to develop improved clinical tools for determining when patients are safe to drive, and assisting policy-makers to develop new regulations to make our highways safer.

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INTERSTRESS
Is a European-funded project

INTERSTRESS

Interreality in the Management
and Treatment of Stress-Related Disorders

The INTERSTRESS project aims to design, develop and test an advanced ICT-based solution for the assessment and treatment of psychological stress.

Objectives:

- Quantitative and objective assessment of symptoms using biosensors and behavioral analysis
- Decision support for treatment planning through data fusion and detection algorithms
- Provision of warnings and motivating feedback to improve compliance and long-term outcome

To reach these goals, INTERSTRESS will use a new e-Health concept: Interreality. What is Interreality? It is the integration of assessment and treatment within a hybrid, closed-loop empowering experience, bridging physical and virtual worlds into one seamless reality.

- Behavior in the physical world will influence the virtual world experience
- Behavior in the virtual world will influence the real world experience

These goals will be achieved through:

- 3D Shared Virtual World role-playing experiences in which users interact with one another
  - Immersive in the healthcare centre
  - Non-immersive in the home setting
- Bio and Activity Sensors (from the Real to the Virtual World)
  - Tracking of emotional/health/activity status of the user and influencing the individual's experience in the virtual world (aspect, activity, and access)
- Mobile Internet Appliances (from the Virtual to the Real world)
  - Social and individual user activity in the virtual world has a direct link with user's life through a mobile phone/PDA

Clinical use of Interreality is based on a closed-loop concept that involves the use of technology for assessing, adjusting and/or modulating the emotional regulation of the patient, his/her coping skills and appraisal of the environment based upon a comparison of the individual patient's behavioural and physiological responses with a training or performance criterion. The project will provide a proof of concept of the proposed system with clinical validation.

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Product Comparison Chart:
fMRI Head-Mounted Displays

RESEARCHER:

Chelsie Boyd
C&R Magazine

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Product	Description	FOV / Resolution	Input Signal	Manufacturer
VRMC fMRI 	A turn-key solution which provides hardware, software, training and support for clinical and non-clinical professionals employing fMRI technology in research and diagnostic procedures.	45 degrees 768 x 1280	VGA	Virtual Reality Medical Center
VisuaStimDigital fMRI 	A dual-display stereoscopic video yields 3D images with 500,000 pixels per 0.25 square inch area. Each pixel is illuminated independently without the need for backlighting, enabling a high contrast ratio.	30 degrees horizontal 0.5 megapixel resolution in a 0.25 square area.	VGA	Resonance Technology, Inc.
Silent Vision 7021 	SV-7021 is a high resolution, binocular fiber optic system. These high resolution (1024x763) fiber optic glasses are all glass-plastic construction, which make them MR inert.	30 degrees horizontal x 23 degrees vertical 1024H x 763V	VESA compatible XVGA	Avotec, Inc.
R-LRO-XG Eye Tracking Systems 	The camera and illumination source uses ASL bright pupil technology that allows flexibility in its set-up. The optics can be positioned 12 feet from the bore. Custom DC power cables are designed to go through your RF filters and penetration panel.	50° horizontal x 40° vertical	Unknown	Applied Science Laboratories
CinemaVision 	CinemaVision is a user-friendly 3D virtual reality system. It provides multiple entertainment options from standard video, television and PC input, while offering two-way communication with technologists.	45 degrees horizontal 240,000 pixels for each display.	VGA	Resonance Technology, Inc.
Kaiser Head Mounted Display 	The system creates a very wide field of view display both horizontally and vertically by tiling six displays per eye. Electronics for the displays extend along the ear pieces on the side of the helmet and distribute the 800 x 600 resolution image into the individual displays.	50° diagonal, 30° (V) x 40° (H) 1024 x 768	XGA	Kaiser Electro-Optics Inc.
Magnet-Friendly VR Fiber Optic Image Delivery System 	This is a noncommercial system which has a relatively high resolution, wide field of view and includes an easy to use fMRI VR helmet. It is currently being used by 5 research teams at the U.W. Digital	67° horizontal x 29° vertical 1024H x 768V	VGA	University of Washington, Human Interface Technology

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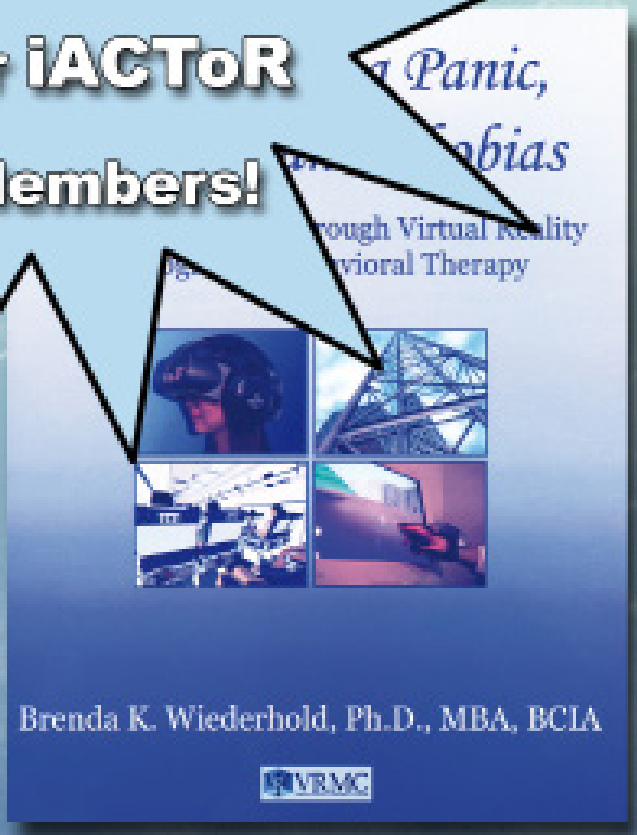

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Conquering Panic, Anxiety, & Phobias

Achieving Success Through Virtual Reality and Cognitive-Behavioral Therapy

By Dr. Brenda K. Wiederhold, PhD, MBA, BCIA

This book is written as a starting point toward helping the large portion of our population that suffers from anxiety disorders to overcome their fears and control their anxiety. It is a resource to enable those suffering from anxiety to take control of their lives and become an active participant in their own recovery.

This book is essentially divided into two parts: a discussion of anxiety and its physical and emotional effects on sufferers. While Virtual Reality Therapy is described, its use is not necessary in order to follow the suggestions in this book. The lessons and worksheets included can help in a variety of areas, not just anxiety, but anger, mild depression, and feelings of helplessness.

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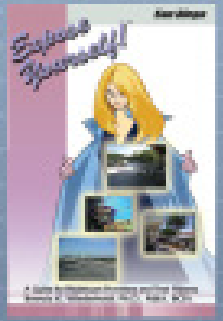

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Ask the Expert:

Q&A Neelie Kroes

Vice-President of the European Commission

Brenda K. Wiederhold: As the Commissioner for the Digital Agenda and one of the Vice Presidents, you have a history of supporting advanced technologies for mental health. Can you discuss some of the aims of the Digital Agenda?

Neelie Kroes: The Digital Agenda for Europe (DAE) aims to help Europe's citizens and businesses to get the most out of digital technologies. They have enormous potential to benefit our everyday lives and tackle social challenges. One of the DAE priorities is the capability of digital technology to support ageing citizens' lives, to revolutionise health services and to deliver better public services. One of the DAE aims is to support research projects for using ICT in health are funded by the European Commission, and I look forward to seeing how our societies can use digital sciences to improve mental health in Europe.

BKW: C&R Magazine is focused on behavioural healthcare and advanced technologies. Can you speak about some of the Commission's priorities in behavioural healthcare?

NK: Mental health is one of the few areas of healthcare in which we have evidence showing the effectiveness of telemedicine. Unfortunately, such evidence is not widely known and in some areas there is not enough evidence available. Therefore, supporting research, development and innovation is one of four main areas of actions presented in the 'eHealth Action Plan 2012 – 2020: Innovative healthcare for the 21st century'.

BKW: You have stressed the importance of using digital technology for health and wellbeing. Can you tell us some of the main priorities in this area?

NK: Considerable effort takes place across the continent to improve healthcare with the use of digital technology. However, this effort has been largely fragmented and could benefit from more cross-border coordination. eHealth tools and services have been widely introduced, but too often health authorities, hospitals, or doctors have chosen to implement their own individual systems. If these systems were able to communicate with each other, the potential benefit they can bring to patients would increase significantly.

That is why our priorities concern wider deployment, international cooperation and interoperability of eHealth services. For the rest, we would like to stimulate research and innovation in this area. In doing so, eHealth projects could create opportunities for real breakthrough research and radical innovation in society. In order to increase the uptake we also aim at increasing awareness and trust among healthcare providers, policymakers and citizens. The latter includes digital health literacy, which could improve public health outcomes in general. All this is part of our eHealth Action Plan 2012 – 2020, which aims at empowering patients and healthcare workers, linking up devices and technologies and investing in research towards personalised medicine in the future.

BKW: What would you consider to be the Digital Agenda's main achievements in behavioural healthcare and its priorities looking ahead to Horizon 2020?

NK: The Digital Agenda and our new funding program for research and inno-

vation, Horizon 2020, focus on personalising health and care – more than 7 billion euros of Horizon2020's 70 billion euro budget is dedicated to health, demographic change and wellbeing. Information and Communication Technology for mental health and wellbeing is a big part of this for a reason. Research and innovation on eHealth technologies for mental health has already considerably improved our understanding of the causes and mechanisms of these disorders – and continues to do so. Research has also improved our ability to monitor mental health and to prevent, detect, treat and manage disease – and we want it to continue this course. So far, a lot has been achieved in supporting older persons to remain active and healthy for longer, and new models and tools for mental health and care delivery have been tested. We are continuing on the same track, and I am confident more important advances are to be achieved in the near future.

BKW: Can you expand on how Horizon 2020's goals will work towards addressing current healthcare challenges facing Europe today?

NK: Our priorities in Horizon 2020 include further development of health and wellbeing solutions for citizens and healthcare professionals for supporting the sustainability of our healthcare systems. We pay a lot of attention on user-centric approaches and on promoting synergies between stakeholders. Breaking the silos is one of the principles of our work. Our focus will also be on analysing large amounts of data for the benefit of all Europeans.

BKW: What do you see as some of the biggest obstacles facing healthcare and technology in Europe?

NK: Firstly, it is a lack of awareness and confidence in eHealth solutions, both among citizens and among healthcare professionals. This is partially due to the limited large-scale evidence of these solutions' effectiveness. But, more needs to be done to make existing solutions more widely available. Second, lack of interoperability between different eHealth solutions. This may be an issue not only across borders, but even across the hospital corridor. The third obstacle, and a very frequent one, is an organisational resistance. Again, to tackle this we need to address the two previously mentioned obstacles, but also to improve general digital literacy, as well as consider legal aspects such as security and privacy issues.

BKW: Do you feel most people are willing to embrace new technologies?

NK: Indeed I do. I come across examples where health organisations, health and care professionals, informal carers and patients step up to the challenge of creating a sustainable healthcare system. They share a vision of a more personalized approach and they are open to innovation. And I am happy that what we are doing in the European Commission is precisely this: we want to offer them as many options as possible to use those technologies that can help them achieve their goals more quickly, more accurately and in a way that is more beneficial to them, to patients, and to European societies.

BKW: What do you predict as the new trends for technology & healthcare for the next decade?

NK: I see that healthcare is getting more and more personalized and preventive at the same time. A lot can be done for maintaining people in good health and wellbeing, as well as to support people with chronic diseases to avoid unnecessary hospitalisation. I think it is of paramount importance for these patients to have doctors remotely monitoring their chronic disease so that they can stay at home longer, in familiar environments, with people they love, without this meaning their medical condition is deteriorated. And I find equally fascinating that smart phone applications can help us all monitor our health status daily, support our physical activity and, ultimately, help us all stay healthier for longer.

Another trend is using the cloud in health. Exchanging information and services in the cloud can help us access this information and these services regardless of the devise we use, regardless of where we are.

Last, but not least, is the potential of our research. EU-funded projects make considerable breakthroughs in many areas. I would like to highlight two of these here: the Human Brain Project, that will try, for the next 10 years, to find out more about how our brain operates and how much it can advance; and the Graphene project, which will explore, during the same period, how this amazing and versatile substance could benefit mankind.

FROM WHERE WE SIT:

fMRI meets Virtual Reality: a new step towards a better understanding of our brain

By Giuseppe Riva

The significant progress of VR technology is demonstrated by the increased availability of professional (e.g. Unity3d) and free (e.g. NeuroVR) VR-development kits that can be used to develop research oriented virtual environments. Specifically, these kits enable researchers to create virtual environments in which participants can interact/navigate and simultaneously to assess physiological indexes and brain functioning.

In particular, the combination of VR and functional magnetic resonance imaging (fMRI) is of great general interest for clinical as well as for neuroscience researchers. First, fMRI represents a crucial method for clinical researchers to evaluate VR's capability to simulate reality and to validate its therapeutic and diagnostic value. For example, the added value of VR therapy in the field of acute pain and motor rehabilitation was strongly supported by fMRI studies. Moreover, neuroscientists can use VR to create more realistic stimuli for fMRI experiments: VR makes it possible to overcome one of its main limitations: the passive role of the assessed subject. The main advantage of VR lies in the presentation and interaction with realistic stimuli. Instead of just watching a movie, subjects can interact actively with VR, for example, navigating and exploring the presented environment. This possibility has been exploited by different VR studies investigating the role of the hippocampus and the parahippocampal area in topographical, spatial and episodic memory processes. In addition, VR has been used to investigate the location of so-called place cells in the human brain.

A recent area of research is the use of VR to track the development of spatial and mnemonic representations in realistic settings simultaneously. To reach this goal, the interaction with VR has been analyzed using multivariate pattern analysis (MVPA) methods and fMRI adaptation/repetition suppression. The available data suggests that realistic VR scenarios in combination with novel multivariate analysis tools could potentially reveal new insights into the organizational structure of mnemonic networks.

These studies suggest that there is much scope for disseminating this approach to clinicians and neuroscientists in order to promote this field of research. Unfortunately, combining VR and fMRI is not a trivial task, as common fMRI software tools do not offer VR support and MRI scanners prohibit head movement.

However, in the last five years different companies have started to offer robust fMRI compatible stimulus presentation VR equipment (e.g. fMRI compatible head mounted displays). These tools together with the increase in computing and graphical power ensure that the marriage between VR and fMRI will allow a significant headway in better understanding our brain functioning.

"…the marriage between VR and fMRI will allow a significant headway in better understanding our brain functioning."

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FURTHER AFIELD:
fMRI: New Weapon in Battling Online Gaming Addiction

By Lingjun Kong

Online gaming addiction (OGA) has become a growing issue around the globe, but China has seen especially abnormal rates in recent years. Internet cafes are often crammed with adolescents, rapidly pressing buttons on their keyboards while yelling gaming jargon to their teammates as they engage in a virtual world online. Weekdays and weekends become intertwined as some of the young boys sleep in the café. This new lifestyle has become a cultural epidemic, many suffering from physical conditions such as gloomy eyes, skinny physique, and frantic rage, indifferent or extremely dissatisfied with the reality. The China Youth Internet Association reported in 2010 that the incidence of OGA in urban youth was approximately 14%. In 2009, a documentary titled "Who Took Our Children" described 30 incidents caused by OGA, including an infamous account of a 17-year-old boy who poisoned his parents.

Fearful of the consequences of this newly emerged disorder that is seemingly sweeping China's urban youth, various institutions have begun crafting solutions to treat the addiction. The most common approach comes in the form of intervention clinics with intense training regimes. Even more draconian measures have been used such as electric shock treatments. Research efforts to understand the mechanisms underlying OGA focus on the disorder's behavioral components, effects on society, and self-reported questionnaires diagnose techniques. However, recently, there have been an increasing number of studies that focus on understanding the neural mechanisms of the disorder.

One of the more promising methods of studying OGA is functional magnetic resonance imaging (fMRI). This technique is an extension of MRI technology which can measure brain activity by imaging changes in blood flow and non-invasively produce real-time diagrams of activated brain regions during internet use. Numerous institutions in China are showing interest in dissecting OGA using fMRI.

In 2011, with support from multiple national institutions and agencies, one research group at the Second Xiangya Hospital in Changsha recruited 19 college students with OGA and 19 students without to serve as a control group. Each subject was shown a video of an online game during a 3-Tesla fMRI scan. Visualizing the difference in brain activations showed increased activity in the right superior parietal lobule, right insular lobe, right precuneus, right cingulated gyrus, and right superior temporal gyrus. The abnormal activation of the right brain in this study interestingly contradicts a popular opinion of Byun Gi-Won, a doctor at the Seoul's Balance Brain Center in Korea, who stated that "heavy users are likely to develop the left side of their brains, leaving the right side untapped or underdeveloped."

Simultaneously, another group led by Dr. Lei Hao from Wuhan Institute of Physics and Mathematics, used diffusion tensor imaging (DTI) with tract-based spatial statistics (TBSS) analysis to examine the microstructure of white matter among 17 OGA subjects and 16 healthy controls. TBSS showed that adolescents with OGA had significantly lower fractional anisotropy (FA) than controls in major white matter pathways. Such abnormal white matter structure may be connected to emotional processing and addiction related behavioral impairments. The study identified that FA can play a critical role as a qualified biomarker in the assessment of the effectiveness of interventions. Furthermore, the white matter integrity may serve as a potential new treatment target for OGA.

As more information is released regarding OGA, researchers are piecing together the neurological components of the addiction. Another study conducted at Dalian Medical University in Dalian, China, found increased brain activity in the dorsolateral prefrontal cortex, anterior cingulate cortex, and right inferior parietal cortex. Each region has been correlated with cravings. Two other task-related fMRI studies using similar cue-induced activation indicated similar brain images to people with substance addiction. With these series of newfound information, researchers began to explore solutions and analyze current efforts of treatment.

One of the popular beliefs among the general population is the idea that family neglect causes youth to look towards online gaming to fill the void. An interesting study conducted by Han et al. evaluated the effectiveness of a 3-week family therapy intervention on the brain activation response using fMRI. Families were asked to help with homework assignments for an hour a day, four days a week, to increase family cohesion. The result was increased activity of the caudate nucleus in response to images depicting parental affection and decreased correlation with images of online games than before the intervention. Their findings suggested that family cohesion may be an effective treatment method to treat OGA and is an important step in finding alternative methods of intervention than current extreme techniques.

The spread of online gaming addiction in China has been a massive issue for many families. Eager to help the nation's youth, various forms of treatment sprung up to stem the outbreak. Now, researchers are arming themselves with fMRI technology to combat the disorder at a neurological perspective in real-time.

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Advancing Healthcare:
Digital Media Plasticity and Human Performance Plasticity

This column introduces apparatus and methods toward advancing healthcare. A Springer published series on the same subject by the author will supplement the column.

By Anthony L. Brooks

Computer Generated Interactive spaces have been used for many years in art to give a specific experience to audiences, e.g. in Museums for Modern Art installations; Performance; and more. Such interactions are designed for single or multiple participants and typically without any sensors being worn.

Relating to intervention within rehabilitation such spaces give opportunity for mapping of an individual's interaction data to digital media content. The individual controls experiences with the content selected according to preferences, profile, and therapist outcome goal of progress (micro-development). Simultaneously the data offers quantitative information of the interactions. This data signifies the individual's exploration of the space as well as responses to their own input. Thus, primary feedback (human movement/performance) causally aligns with secondary feedback (mapped digital media).

Plasticity in this context relates to change, i.e. how digital media is increasingly flexible and receptive to change and how such a change can affect a human change through traditional or alternative sensory channeling in order to change experiences and relationship to what is interacted with where ability micro-development is targeted.

Increased uses of worn biofeedback systems, especially with dry sensors that require minimal setting up, are being seen. Such systems enable even those with profound disability to participate. Open (non-proprietary) systems are becoming available to enable increased opportunities for intervention. Increased access to play digital games is possible through a new range of commercial peripherals or bespoke apparatus. These are usually referred to as Natural User Interfaces (NUI) and Perceptual Controllers. Computer Vision and sensor technology advancements have largely been responsible for this empowerment. As healthcare practitioners such as physical therapists adopt games, there is a limitation through the innate fixed structure trees. To complement such a fixed environment, abstract interactive environments that empower user-tailored creative expression are also available to be used in rehabilitation to offer increased opportunities of adaption. Thus, the digital content can be direct manipulation of auditory, visual or other stimuli to enable more specific tailoring to match participant preferences for interaction.

Through such systems quantifiable data of interaction (primary and secondary) can be matched to qualitative data observed and otherwise gained from the designed interactions and planned-for responses.

Whilst a designer exploring digital media plasticity aligned to exploit human performance plasticity and its complexities is challenged through the need of transdisciplinary experiences and creative "out of the box" thinking, it is especially challenging for the therapist/facilitator/carer who is the catalyst of the 'in-action' change-based intervention. Thus, actions are needed to provide specific training of such ICT towards addressing citizen-centric competences across future demographic societal changes and predicted service industry shortcomings in order to fully advance this perspective of healthcare, wellness and quality of life.

In line with the above a dedicated consultancy, expert assessment, and residential training retreat has been established as a European SME titled "SoundScapes" - contact below.

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Tech Impact:
Big Data's impact on Intellectual Property

In this new column IP strategist Joren De Wachter writes about the impact of technology on certain aspects of society

By Joren De Wachter

Big Data is the name given to the phenomenon of the ever-increasing generation, communication and use of data. Roughly, the amount of data generated by humanity doubles every 12-18 months. The current estimate is that humanity generates 2.3 quintillion bytes (or 2.3 trillion Gigabytes) of data per day in 2012.

Big Data is often described through its characteristics Volume, Velocity, Variety, and Veracity (the four V's). Volume stands for the amount of data generated. Velocity refers to the speed of data exchange. Variety stands for the different kinds of data, and their different sources. Finally, Veracity reflects on the potential use of data, and how "true" they are.

But two additional characteristics of Big Data will be relevant for this article. The first characteristic is reflected by the word "Big". Humans tend to underestimate, or ignore, the consequences of exponential growth. Not only is 90% of all existing data in today's world less than three years old, but the vast amounts of data created today will be dwarfed into insignificance, and represent, by 2020, less than 5% of the world's knowledge. These data come from many sources. Some are machine-generated data, but there are many other important data sources. More and more governments open up the data they generate and use. Scientific knowledge and research is shared through open innovation, open research and open education. Raw data from an exponentially growing number of sources adds to our available knowledge. Many user-generated data sources are emerging such as personal health monitoring systems. In both real and virtual medical situations, the growth of empirical and environment data will not only vastly increase the amount of information available, but it will also affect the way in which that information will be used. For example, knowledge of prescription behavior make it easier to find immediate correlations with hospital visits or other consequences, leading to a layer of knowledge in real life – complementing or sometimes even supplanting traditional double-blind tests. The second characteristic is the importance of fluid and adaptable analytics. As the data flows grow exponentially in Volume, Variety and Velocity, the tools we use to analyze, manage and address these data, need to be adapted continuously. This means that any algorithm developed or applied for using Big Data will, necessarily, have to be adapted and modified continuously, in order to react to and remain relevant towards the changes in Big Data.

Impact on Intellectual Property

This article will limit its observations to the impacts on the patent system, while acknowledging that the IP system (including copyright, trademarks, know-how and trade secrets) is much wider than that.

Patents are a system of exclusive (monopolistic) rights that are granted by the state for inventions that are a) held to be of a technical nature, b) new (there must be no "Prior Art") and c) non-obvious (they require the so-called "Inventive Step"). While patents currently play a relatively important role in certain business models in the healthcare industry (particularly those based on exclusive rights in manufacturing certain drugs or other chemical compounds), we can already see how Big Data will have a profound, and potentially shattering, effect

on how patents are used in this industry. The first key observation is based on the assertion that Big Data equals Prior Art for the purpose of patentability, or that, at the very least, Prior Art is a substantial subset of Big Data, with the same characteristics. Combined with the simple observation that the number of patents doubles, on average, every 20-25 years (a rate that cannot be significantly increased within the current patent system), this means that, as the amount of Prior Art grows exponentially, the rejection rate for patent applications will necessarily have to rise to 100% for lack of novelty. In other words, Big Data will make it impossible for patent applications to be "new".

Arguably, this process is starting to become visible, such as in the patent warfare around mobile phone technology, where the most common outcome of litigation is the revocation or invalidity of most patents invoked. However, four factors are currently slowing down the impact of the rise of Big Data Sea submerging the patent atolls. First, the patent offices tend to focus their research of novelty on the information contained in their own databases of patented technology (thereby largely ignoring that those databases lose roughly 50% of their information relevance every 18 months). As a result, the patent offices fail to stop issuing patents on non-novel technology. Second, there is a serious time lag between the moment a patent application is filed, and the moment it is declared invalid for lack of novelty by a court of law (the two processes combined can easily take up to 5 years). Third, it is quite expensive to put up a litigation defense and have a patent that was granted on a non-novel invention declared invalid. Fourth, some procedural rules limit the way in which Prior Art can be invoked in order to invalidate a patent (effectively allowing a monopoly on old technology).

Yet, there is no doubt that a novelty-based patent system cannot survive in a world where information doubles every 18 months.

The second key observation is that the capability to analyze and use Big Data, through the use of algorithms (even when they are novel) does not fit very well with the patent system. A patent is a "frozen" algorithm. It takes a snapshot of an algorithm, and provides exclusive protection on that particular version. While it is in theory possible to patent wider algorithms, those patents tend to be very difficult to enforce, and/or easy to circumvent.

As we have established, the value of algorithms in a world of Big Data is not their static existence, but their adaptability and variability over time. In its current state, the patent system is very poorly equipped to deal with this, and patented algorithms (if and when such patents can be obtained, which is not obvious, since an algorithm is, at heart, an idea, and not a technique) will have relatively limited value. Throw in the commoditization of algorithms themselves as a result of increased information and knowledge (our exponential effect of Big Data again), and it is clear that patenting algorithms is not a cost-efficient or workable answer.

Big Data is like a fast growing river system. Its value is in access to the flow of the river and the expanding river system, not in ownership of one particular source, or even ownership of a piece of land alongside it. The value of Big Data is in the flow – and patents just don't capture that.

Consequently, we should expect to see some important changes in the way investors will look at the role of Intellectual Property, not only in virtual reality based healthcare, but in many other technology markets as well.

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C&R in Greece

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"During the last five years, numerous and systematic efforts have been made for developing, designing, and deploying advanced and personalized ICT health systems in Greece."

Greece is a mountainous, peninsular, Southeastern European nation that lies at the intersection of Europe, Asia, Africa, and the Middle East. Having emerged early in human history, Ancient Greece continues to hold significance all around the globe, especially in Western culture. It stands as the foundation that gave rise to the alphabet, political science, significant scientific and mathematic principles and democracy.

Greece took over the rotating Presidency of the Council of the European Union in January which will provide an opportunity for the country to showcase its plan for comprehensive health system reform. In a recent speech, the Health Minister Andreas Lykourentzos stated that health is a fundamental human right and emphasized the crucial role it plays in people's welfare and sustainable development. The Ministry of Health aims to ensure the good health for residents of Greece, creating equal access to health services, particularly for vulnerable groups most affected by the economic crisis. Minister Lykourentzos has also highlighted that healthcare reform is not simply about expenditures, but rather it should be seen as an investment thereby encouraging growth of the health sector
Mental Healthcare in Greece

The government run National Health Service has a number of special psychiatric hospitals, in addition to those offered by many private hospitals and universities. Greece has been developing a range of services in its hospitals which include inpatient services for the past ten years. However, the provision of mental healthcare varies greatly between the different regions, particularly with regards to the inefficient organization of primary care.

Studies have shown that 14 - 16% of the general population suffer from a psychiatric disorder, a figure which is similar to other western populations. Drinking is quite high in the general population and about 5% of the population use illicit drugs.

The Impact of the Economic Crisis

After years of reform and social turbulence, Greece's increasingly fragile political stability has left the country in a state of unrest. Following the start of Greece's economic crisis, the general mental health of its citizens has been steadily on the decline. The quality of life in Greece is heading south and a there has been general sense of helplessness among the younger population. As the country continues to spiral downwards, citizens are subjected to worsening the physical, emotional, and mental conditions.

Studies have found that the crisis has taken an immense toll on the mental stability of the younger generation of Greeks, leading to an increase of mental illnesses and health concerns. There has been a dramatic increase in suicides the last few years and deteriorating conditions only call for more attention to the public from officials and medical institutions. Greek healthcare, however, is universal and has been consistently ranked one of the best in the world, despite many Greeks calling for reform. Amongst the other European Union member states, Greek healthcare costs are also one of the lowest. Nevertheless, following five austerity programs in the past two and a half years, there have been reductions in Greece's healthcare system.

The economic crisis and the resulting austerity measures have made mental health care provision more difficult. Activists from the psychology and social care sector have tried to bridge the gap by creating community centers and by providing free therapy and counselling services.

Research Facilities in Greece

During last five years, numerous and systematic efforts have been made for developing, designing, and deploying advanced and personalized ICT health systems in Greece. However, while there

Population (Million)	10.77
Life Expectancy (Male/Female)	77/83
Fertility Rate	1.4
Population Median Age (Years)	43.2
Annual Population Growth (%)	0.04
Population Density (Persons Per Sq. Km)	82
Hospital Beds per 100,000	4.8
Gross National Income Per Capita ($)	24,790
Total Expenditure on Health (% GDP)	10.8
Internet users (million)	5.7
Internet Addiction Prevalence Rate	8.2
Admissions to Mental Hospitals (per 100,000)	78.92
Suicide Rate (% increase from previous year)	26

has been demand for such services, the results are currently unclear. Within the next decade, the government aims to provide more e-health services as part of its National Health Services reforms. Individual efforts and innovations have been achieved by research institutes and hospitals under the auspices of European Union research projects and national funded programs.

Hellenic Association for the Study of Internet Addiction Disorder (HASIAD)

One organization to rise to the forefront of medical research during these harrowing times in Greece is the Hellenic Association for the Study of Internet Addiction Disorder (HASIAD), a scientific nonprofit association that aims to challenge the ever-growing problem of Internet Addiction Disorder (IAD). HASIAD's goal is to ensure the implementation of appropriate actions for the recognition and prevention of IAD, as well as to provide training for mental health specialists and other health professionals, raise awareness about its consequences and to set up programs to support those addicted to the Internet as well as their families, and continue the education of health professionals.

Heading the association are President, Dr. Konstantinos Siomos and Vice President, Dr. Georgios Floros. In an interview, Dr. Floros stated that "HASIAD's academic relations stem from the fact that three members of our association hold PhD's or MSc degrees on Internet addiction while another ten are currently working towards their degree," also adding on that "members have played a pivotal role in the setting up of the first specialized outpatient services for adolescents and University students affected with IAD."

Advancements in the Field

Aside from research and writing, HASIAD has been actively moving in the medical community creating connections, establishing networks of organizations and individuals. In addition, the organization has begun providing services to increase awareness of Internet Addiction and how to recognize and treat it. For example, recently HASIAD began a pilot training program aimed at mental health professionals who are looking to learn how to treat IAD. HASIAD is also developing a separate program to guide educators on teaching their students how to recognize the dangers of IAD. These programs will be tailored to the specific needs of each professional community and will include lectures, workshops, and clinical supervision by HASIAD's experts.

At the same time, they have implemented a public awareness program, sponsored by Vodafone Greece. The program, which has been running for the past two years, exists to alert the general Greek population on the dangers of addictive online behaviors. It features open presentations capitalizing on the threat of cyberbullying, and cyberharassment, and has also yielded an online-safety guide for parents available in print and online. They maintain a working partnership with the Cyber Crime Unit of the Hellenic Police in order to promote safe online use, and have also contributed in a number of joint research proposals under the school education EU Comenius program. HASIAD has also been involved in research projects with several mental health organizations all throughout Greece, including the Organization Against Drugs (OKANA), Institute of Psychosocial Development and the Universities of Thessaloniki, Thessaly and Athens.

Centre for Research and Technology in Greece (CERTH)

Another organization which is contributing to the growing field of ICT health systems is the Centre for Research and Technology in Greece (CERTH) which focuses on applied research in various fields. The Hellenic Institute of Transport (HIT), a division within CERTH, provides state of the art research and creates innovation in the field of Transport in Greece and in Europe. They aim to provide services that produce scientific results, implementable outcomes and specialized knowledge, to support policy and decision making in the field of Transport in Greece.

The HIT's Domotics Lab carries out leading research for those who are mobility impaired (ASK-IT, OASIS, UNIVERSAAL, SAVEME, VERITAS European Projects) and for older chronic patients living in geographically isolated areas (REMOTE). Software applications are being developed which create personal profiles for users who are then able to control some of their home appliances remotely via mobile devices (e.g. control white goods, check thermostat). HIT is also a member of the European funded project INTERSTRESS, a mobile product for reducing stress.

HIT has developed applications to enable older citizens to increase their quality of life and allow users to organize their journey according to their accessibility needs and the accessibility characteristics of the places they intend to visit and of the different possible transportation means or paths (e.g. accessible pavements). They are also able to remotely control home appliances with an onsite home installation as well as with the connected domotic lab. They can then receive information on social and personalized services during their trip and, in general, enjoy all amenities of a trip in a personalized and accessible manner. Additionally, blind users can receive direction information and geo-information along tactile bands specifically equipped with active radio-frequency identification. HIT's fundamental scope is to revolutionize the interoperability, quality, breadth and usability of services for all daily activities of older people and isolated patients. Specifically, research aims to utilize ICT and other key technologies in order to provide holistic services to older people in order to support their physical and psychological independence, stimulate their social or psychological engagement and foster their emotional well-being.

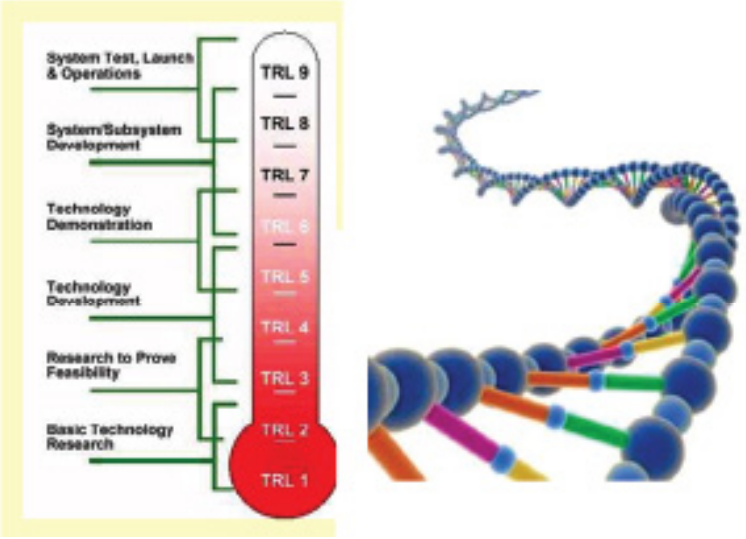

Figure 1. National technology Readiness Level for technologies related to Bioinformatics (Source: Network for Development of Business and Technology Information, Annual Report for Health 2012)

A target for the near future is to communicate knowledge on using new technologies for improving not only patient health but prevent health-related problems as well as mobility issues afflicting those who are isolated by providing personalized technologies directly to users.

Looking Ahead

Opinions concerning the future of Greece have been consistently bleak with a majority of the news surrounding the country being negative in nature. It is difficult to determine when Greece will be able to overcome its downturn and how long it will affect the people. As it is tragically easy to dwell in the realm of the doom and gloom, it may be difficult for people to recognize and readjust themselves to an improving lifestyle. Researchers, however, are continuing to advance their studies and make breakthroughs in the field of health research in Greece. The research done by HASIAD and HIT is therefore of the utmost importance. Efforts continue to pour forth from the willing minds of researchers and scientists to understand these behaviors and conditions. It seems the path cannot be too dark if there are still those willing to illuminate it.

Sources:

Georgios Floros, MD, M.Sc
Konstantinos Siomos, MD, Ph.D
HASIAD

Evangelos Bekiaris, Ph.D.
Aikaterini Touliou
Hellenic Institute of Transport (HIT)
Centre for Research and Technology (CERTH)

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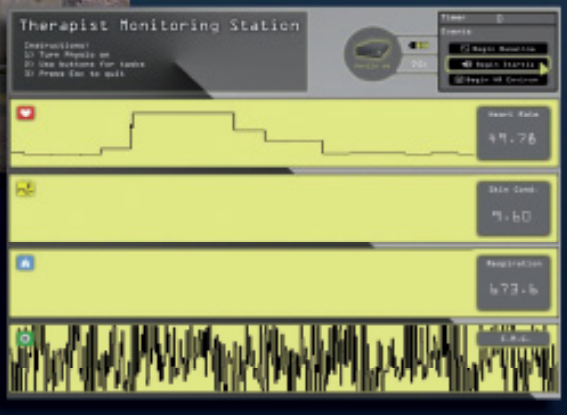

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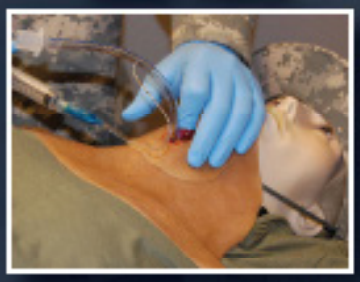

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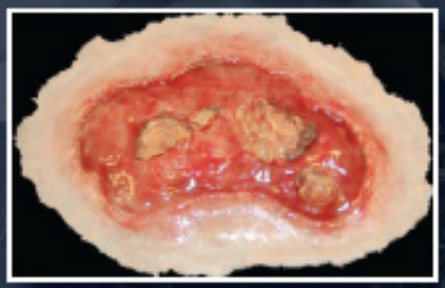

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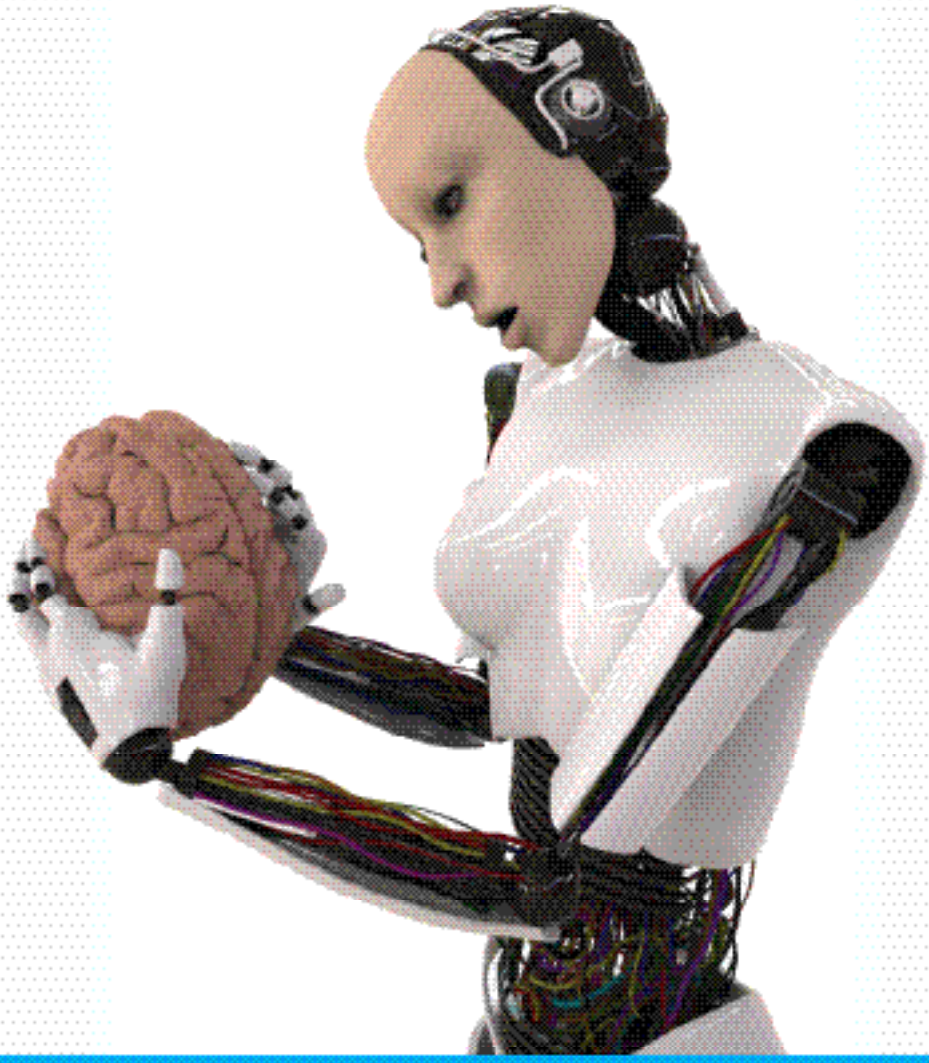

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