CyberTherapy & Rehabilitation

Issue 2 / 2009

The Official Voice of iACToR

FEATURES:

COVER STORY:

New Mobile Platforms

Launch iRehab Applications

PRODUCT COMPARISON:

COUNTRY FOCUS:

ISSN 2031 - 278

Letter from the Publisher

Professor Dr. Brenda K. Wiederhold

"The field of rehabilitation is rapidly improving with the use of virtual reality, handhelds and mobile health services..."

Dear Reader,

I would first like to welcome all our new readers and thank our returning readers of CyberTherapy and Rehabilitation Magazine (C&R), the official voice of the International Association of CyberPsychology, Training and Rehabilitation (iACToR). iACToR, formerly known as the International Association of CyberTherapy and Rehabilitation (IACR), is an international association dedicated to the promotion of virtual reality and advanced technologies as an adjunct to more traditional forms of healthcare. It also addresses issues concerning technology's role in altering behavior on both an individual as well as a societal level.

As well as thanking readers for their encouragement and support, I would like to specially thank C&R's Editorial Board members' unending dedication as well as the Management Board and Founding Members of iACToR. With our combined communications platform we have successfully formed affiliations with several other associations, conferences, publications and institutional partners to further strengthen the goals of the association and reach out to experts, academic peers, industry leaders and government officials.

This issue we focus on iRehab, specifically the way in which new technology is applied to rehabilitation, both in the mental and physical healthcare sectors. Everywhere around us, we hear of change in this direction, from phone applications helping users become healthier through tracking food consumption to medical centers across the country using Twittercast to reach out to patients and students. The Twitter medium has become so popular that it recently helped lead to the successful bone marrow transplant of a five-year-old girl in New York City. As the use of advanced technology in these fields has become more established throughout the world, we now turn our attention not only to Europe and the U.S. but look further afield to its implementation in Asia.

Our lead article discusses the surge in mobile platforms and the ways in which they affect handhelds and iRehab applications. Next, we take a closer look at mobile health and handhelds, in particular, in our Product Comparison Chart. The positive effects of interactive rehabilitation will be explored and the reader will be introduced to the notion of a "handheld generation" and the effects of technological innovations in this area. Following articles discuss the effects of virtual reality exposure on patients with eating disorders and returning war fighters suffering from stress and pain. A study measuring presence in virtual reality environments is presented and lastly, an article on surgical simulation. I would like to sincerely thank contributing authors for their time and energy. These articles and studies are helping to pave the way for new advancements in healthcare and C&R is proud to be a part of the movement.

Looking to the future, upcoming issues of C&R will discuss topics such as robotics, brain imaging, cognitive enhancement with technology and much more. There is a wealth of advanced technology for healthcare, and C&R will continue to dedicate itself to bringing you news of exciting developments in this field.

I hope that new and returning readers alike find these topics stimulating and use the material to foster new relevant ideas. We welcome readers' input so please contact me, or the C&R Managing Editor, Emily Butcher, at office@vrphobia.eu, with your comments and suggestions.

Create your own reality!
Brenda Wiederhold

GENERAL INFORMATION

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CyberTherapy & Rehabilitation Magazine is published quarterly by the Virtual Reality Medical Institute (VRMI), 28/7 Rue de la Loi, B-1040 Brussels, Belgium. The magazine explores the uses of advanced technologies for therapy, training, education, prevention, and rehabilitation. Areas of interest include, but are not limited to, psychiatry, psychology, physical medicine and rehabilitation, neurology, occupational therapy, physical therapy, cognitive rehabilitation, neurorehabilitation, oncology, obesity, eating disorders, and autism, among many others.

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Handheld Devices

The rate with which the healthcare industry is turning to handhelds is growing rapidly. With iPhone applications becoming more widespread and accessible, healthcare companies are turning to these tiny computers and other handheld devices to launch new forms of communication and information for both physicians and patients.

Interactive Rehabilitation

The applications of virtual reality in rehabilitation offer a new and exciting field of research. Existing studies have proved promising effects can be achieved by engaging patients in interactive rehabilitation. The immersion and presence felt in virtual environments encourage users to fully participate in the experience, yielding better results when applied to rehabilitation patients.

International Association of CyberPsychology, Training & Rehabilitation (iACToR)

Conference Participation Report Summer/Fall 2009

HSI 2009:

Conference on Human System Interaction

Catania, Italy / May 21-23, 2009

iACToR and JCR Board Members participated in the HSI 2009 Conference on Human System Interaction. Professor Luciano Gamberini chaired the session on Telemedicine and eHealth. In this session, Professors José Gutiérrez Maldonado and Mariano Alcañiz also gave presentations. Professors Andrea Gaggioli and Giuseppe Riva chaired the session on Positive Technology. Additional speakers included Professors Cristina Botella and Rosa Baños.

Topics discussed during the conference included human machine interaction, enabling technology for remote system interaction, human system interactions in transportation, and control system resilience.

For further information, please visit:
http://www3.unict.it/hsi09/

MT3: The Medical Technology, Training and Treatment Conference

Orlando, Florida, U.S.A. / May 28-30, 2009

In late May 2009, the MT3 conference assembled prestigious speakers, exhibitors and two workshops to showcase innovative healthcare technologies, training and treatment. The Medical Technology, Training and Treatment conference brings together leading physicians, health care providers, technologists, educators and industry leaders to stimulate discussion about current and evolving medical discoveries, training and education. In 2009, MT3, in partnership with the University of Central Florida, offered CEUs. In 2010, in partnership with the American College of Surgeons, the conference will offer CMEs (in addition to the CEUs offered by UCF). Conference attendees will hear discussions about technological advancements; discuss changes in resident training requirements; robotic developments; games for health; and procedures to improve patient safety and quality of care. The purpose of the conference is to improve 21st century medicine. Plan now to participate in MT3 2010 May 6-8 in Orlando, Florida.

For further information, please visit:
http://www.mt3.bz.

Beyond Brain Machine Interface: Motor, Cognitive, Virtual

Minneapolis, Minnesota, U.S.A. / September 2, 2009

The Interactive Media Institute, along with conference chair Dr. Brenda Wiederhold, organized this scientifically rigorous one-day symposium on Non-Manual Control Devices, which brought together eminent experts working to offer a more efficient and intuitive way of achieving system control than manual manipulation, and allowed for discourse and product exhibition among academics, members of the scientific community, biomedical device engineers, and the clinician user community The scope of the conference was general in nature to focus on the interdisciplinary fields of biomedical engineering and included presentations on imaging, biosignals, biorobotics, bioinstrumentation, neural rehabilitation, bioinformatics, healthcare IT, and medical devices.

This symposium also served to advance the Army Research Office's mission as the premier extramural basic research agency in the engineering, physical, information, and life sciences. The one-day workshop was co-located with the September 3-6, 2009 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS), which attracts 2,000 attendees from 50 countries.

For further information, please visit:
http://www.interactivemediainstitute.com/

International Symposium on Rehabilitation

From Basics to Future

Valencia, Spain / October 15-16, 2009

Seeing the need to strengthen the collaboration between technical and health related disciplines, the International Symposium on Neurorehabilitation: from Basics to Future was held in Valencia, Spain and was co-chaired by Professor Mariano Alcañiz. The main purpose of the Symposium was to bring together engineers, researchers and health care professionals to share ideas and experiences with the aim of creating a "common language" that will help to increase the efficacy of the neurorehabilitation process and to improve the quality of life of patients.

For further information, please visit:
http://www.serviciodc.com/

14th Annual CyberTherapy & CyberPsychology Conference

Lago Maggiore, Italy
June 22-23, 2009

The 14th Annual CyberTherapy & CyberPsychology Conference (CT14) co-organized by Professor Brenda K. Wiederhold from the Interactive Media Institute and Professor Giuseppe Riva of the Istituto Auxologico Italiano, took place in June 2009 in Verbania, a picturesque location on Lago Maggiore, Italy. CT14 was hosted in Villa Caramora, a historical building owned by Istituto Auxologico Italiano, and attracted researchers from 27 countries around the world. According to Alessandra Gorini, the Conference Coordinator, "it was a great international success that brought together researchers, clinicians, policy makers and funding agents to share and discuss advancements in the growing disciplines of cyberpsychology, cybertherapy, training and rehabilitation."

Under the direction of Professor Stéphane Bouchard, Workshop Chair, CT14 kicked off with pre-conference workshops on Sunday the 21st of June, which focused on multiple aspects of cybertherapy from introduction classes to specific uses for virtual reality (VR) and other advanced technologies such as treatment of Posttraumatic Stress Disorder, brain computer interface, presence, cognitive and motor rehabilitation and VR for the treatment and prevention of anxiety disorders.

The conference officially began on Monday the 22nd of June, with welcome remarks from the Conference Chairs, Professor Brenda K. Wiederhold and Professor Giuseppe Riva, followed by the fascinating keynote lecture entitled "Advances in Technology for Cybertherapy" by world-renowned speaker Dr. Richard Satava.

Monday's program included three plenary sessions and an expert panel discussion coordinated by Professor James Spira on the following topics: advances in telehealth experiences, VR and pain, VR and the brain, and future directions in the technological advances in prevention, assessment, and treatment for military deployment mental health.

Tuesday's events included eight parallel sessions whose topics were: VR for the treatment of anxiety disorders, cognitive and spatial assessment and rehabilitation, interventions for the treatment of addictions, the treatment of posttraumatic stress disorder, virtual online interactions and the psychology and psychopathology of the web. The conference was closed by the general assembly of the International Association of CyberPsychology, Training, & Rehabilitation (iACToR) coordinated by Secretary General Brenda K. Wiederhold and presided over by President Christina Botella.

One of the most attractive and innovative events of the conference was the "Cyberarium and Cyberfashion for Well-being" that took place at lunch time on the 22nd in the main hall of Villa Caramora. As in the previous CyberTherapy conferences, the Cyberarium represented a high-profile event open to the press, which

The main hall of the Villa Caramora (ground floor) and the the poster exibition (first floor).

showcased the most advanced interactive exhibits and research and drew a substantial crowd. The "Cyberfashion for Well-being" event included a fashion show of the most innovative wearable technologies that are becoming part of the everyday fabric of society. These wearables are allowing patients access to continuous monitoring as well as allowing individuals who want to prevent disease to monitor their own health status.

The conference ended with a social dinner on the lake and an awards ceremony honoring those who have excelled in the field of cybertherapy.

Three categories of awards were given for outstanding achievements in CyberTherapy:

–The 5th Annual CyberTherapy Excellence in Research Award
–The Annual CRC-Clinical Cyberpsychology New Investigator Award for a presentation of outstanding research quality
– Four student poster awards

The 15th Annual CyberTherapy & CyberPsychology Conference will take place in Seoul, Korea on June 13-15, 2010. Professor Brenda K. Wiederhold and Professor Sun Kim of Hanyang University will serve as Co-Chairs.

For more information on the conference, please visit the Interactive Media Institute's Web site at www.interactivemediainstitute.com.. or e-mail the CT15 Conference Coordinator James Cullen at cybertherapy@vrphobia.com.

New Mobile Platforms Launch iRehab Applications

mHealth is a term used to describe healthcare services provided by mobile communications and wireless technologies utilizing technologies such as mobile computing, medical sensors and wireless communications. mHealth provides cost effective, easily accessible and overall better solutions for rehabilitation efforts.

By Lingjun Kong

There is no doubt that the wireless revolution has had a remarkable impact on society and people worldwide. Inevitably, this technological trend has found itself becoming an essential progression and is rapidly spreading through the medical sector. Mobile Healthcare, commonly known as mHealth, is a term used to describe healthcare services provided by mobile communications and wireless technologies. Exploiting technologies such as mobile computing, medical sensors, and wireless communications, mHealth provides cost effective, easily accessible and overall better solutions for rehabilitation efforts. By allowing healthcare professionals, hospitals, and patients to interact on a more real-time basis, mHealth is dramatically changing and improving healthcare communications in rehabilitation therapy, training, and education.

Figure 1: Cell phones have become an integral tool in mobile health.

Key Drivers

Value Proposition: Conscious of the value proposition and future of this emerging technology, large business corporations are jumping on board with mHealth healthcare services. High profile companies such as GE and Intel, UnitedHealth Group, Cisco, QUALCOMM, and many others are investing and launching products that help drive the next wave of wireless and mobile healthcare technology innovations. To provide better communication between patients and healthcare providers Microsoft's HealthVault allows patients to store their healthcare information in one convenient location, Philips Healthcare's wireless handheld devices offer patients in-home medical care services and GE's QuietCare gives seniors a monitoring system that signals emergency situations to their healthcare providers. Various efforts are being undertaken to meet the demand of mHealth and many are joining together in collaboration. For example, the Wireless-Life Sciences Alliance is an organization that puts innovators and wireless health companies together with global leaders in healthcare and technology to accelerate business opportunities.

Patients: For many rehabilitation patients, the cost of physically traveling to a hospital for routine check-ups and services is escalated by their conditions and prevents them from getting needed treatments. Those with chronic conditions want to have access to quality healthcare services at the convenience of their own homes. By providing wireless tools for better patient care at home, healthcare professionals will enhance their management of ill patients with chronic conditions. According to The Department of Health and Human Services of the United States, 60% of individuals below the age of 65 have at least one chronic condition. As for the senior population over 65 years of age, about 77% have two or more chronic conditions. The amount of resources spent on chronic disease care accounts for an unnecessarily large proportion of healthcare expense in the

US – about 90% of the gross domestic product. The growing number of patients and large amount of expenses spent towards their treatments makes the convenience of telecommunications vital.

Doctors: Doctors view the wireless capabilities of mHealth as a way to improve treatment for all patients. mHealth provides physicians with upgraded tools to treat patients. With wireless technology at their fingertips, they are better equipped to manage and diagnose patients to prevent disease. Doctors favor these improvements in mHealth that allow them to provide treatments and services and efficiently meet overwhelming demands from patients.

Innovators: Because the mHealth is a relatively new field, it provides many frontiers for researchers to explore and attracts many researchers who want to improve it. To these innovators, mobile technology offers challenges for them, pushing them to take the existing technologies to the mobile level.

Applications

Innovations in wireless and mobile healthcare have grown surprisingly fast. By allowing real-time interaction between clinicians and patients, mHealth is enabling a shift in healthcare communications. Many forms of mobile application have existed in the medical sector such as patient scheduled doctor visits, access to copies of patient medical records, remotely monitored patient data and locations of appropriate hospitals based on requirements, rating etc. Presently, a wave of wireless applications is surging including vital sign monitoring devices that can track weight, blood pressure, heart rate, and pulse oximetry and home health gateways that help bridge patients' homes and healthcare providers. From the intricate high-end technologies to the simple free application on the iPhone, mHealth is spreading to both professional and casual users. Moreover, mobile devices are capable of playing a key role in remote management of patients with rehabilitation conditions. Patients can collect data from biometric devices at remote locations and upload and send the physiological data to their physicians where it could be electronically monitored. Physicians can then evaluate the data and take action when necessary.

iMAT, Mental Armor Training, is a mobile neuropsychological training program that serves to enhance soldiers' abilities to form accurate interpretations of the events they experience during deployment and in everyday life. The application permits users to complete a series of exercises designed to improve judgment during stressful situations. The program provides different levels, each asking the user to apply their training to personal experiences. iMAT takes advantage of mobile platforms during overseas deployment to aid in the study of U.S. Army National Guard to determine appropriate physiological and cognitive interventions.

CardioNet, a mobile cardiac telemetry technology provides ambulatory, continuous, real-time outpatient management solutions for patients with cardiopathy. It utilizes wireless medical technology to provide a portable wireless monitoring device to keep track of patients' heartbeats 24 hours a day for an extended period of time. CardioNet's initial efforts are focused on the diagnosis and monitoring of cardiac arrhythmias or heart rhythm disorders, with a solution that markets it as Mobile Cardiac Outpatient Telemetry MCOT™. The newer enhanced version allows physicians to access more in-depth data to better diagnose atrial fibrillation, abnormal beats, and ventricular tachycardia (a potentially dangerous fast heartbeat). With the trended heart rate data provided by MCOT™, physicians are able to make clear and efficient clinical decisions to their patients based off this normally unattainable data at the hospital.

The Power of the Cell Phone

The mobile phone has become the most favored platform for innovation in the medical sector. With 4-billion total mobile subscribers, cell phones are not only growing in popularity, but also in computing capabilities. New features are added everyday making the cell phone a diverse personalized miniature computer. The inventions of medical professionals and researchers are turning the cell phone into a mobile hospital.

Platforms (Devices): From the mature platforms such as Symbian, BREW and Windows Mobile, to the current dominators of the mobile applications such as Android and iPhone, cell phone platforms have presented a diverse environment available to medical researchers (see Table 1).

Android: Growing at a rapid pace, Android is a hot phone platform built on top of the Linux kernel, and has come a long way in a relatively short time. Although at an early stage of its life, Android will certainly have a dominating presence in the near future. Launched in November 2007, Android, owned by Google, and now under the control of the Open Handset Alliance (OHA), promotes a free open-source operating system based on Linux for mobile devices. As the only full-stack free open source operating system, opening access to all levels of the operating system, Android offers third party developers opportunities to write applications in Java programming by utilizing Android API. Compared to other platforms, it not only is able to access the multitude of Google applications, but also does not require re-development for porting among different cellular devices. A significant feature that differentiates Android from the iPhone platform is that Android officially supports background processes in third-party applications.

iPhone: With its numerous applications, the iPhone has become a household name even in the medical world. Currently, no other phone can compare to its powerful distribution channel and social impacts to influence millions of everyday consumers and clinicians. From casual widgets, such as a drug interactive checker, clinical reference tools, medical news, and contact information for physicians, pharmacies and hospitals, to more sophisticated services such as a stethoscope, a game to diagnose diseases and an emergency radio, patients and doctors are enjoying these interactive tools at their convenience. The iPhone has not only evolved into more than a consumer electronics device due to its attractive interface, applications marketplace, and consumer appeal, it has also been heavily integrated into the medical field via high resolution medical images and various software applications.

Challenges

Mobile technology in the healthcare field is still in an early stage and requires a selection of hardware upgrades, such as ultra-low power usage, computation, and communication for overall extended battery life. However, the main issues revolve around security, interoperability, and regulatory compliance areas.

Security: The privacy of patients' data becomes a pressing issue in the development of mHealth technology. Since most casual services only offer a username-password combination to access sensitive data, many users are cautious about giving away the needed information that is required of them. The relative ease of leaking personal information, including identification and medical histories, makes the need of well-regulated security policies extremely important as mHealth continues to proliferate.

Interoperability: Due to its fast growth and relatively new technologies, mHealth services do not boast interoperability, meaning services provided by one platform may not be understood or transferred to services offered by another. Medical devices are frequently not configured in the same way by the device vendors and as they are by the network infrastructure. Although cellular, Blue-Tooth, and Wi-fi standards have been well-established, developing technologies are constantly shifting and standards will take time to become concrete.

Table 1: Platforms

	Symbian	BlackBerry (RIM)	iPhone OS	Android	Windows Mobile	BREW
Unique Feature	Low-Power, Fast Response Time	Push Email, QWERTY Keyboard	Long Battery Life, Accelerometer	Full Stack Free Open Source	Easy Synchronization	Disable/Restore
Programming language	C++, Java ME	Java	Objective C	Java	C++	C/C++
Multitasking	Yes	Yes	No	Yes	Yes	Yes
Security	Symbian Signed Certificate	Triple DES, AES Encryption	Device Remote Wipe	Mandatory Access Control (MAC)	ActiveSync, Remote Wipe	Multi-level App. Signature
Development Period	Slow	Fast	Fast	Fast	Medium	Slow
Release Time	June 1998	April 1999	March 2008	Oct. 2008	June 2003	Sept. 2001
Integrated Development Environment	Carbide C++	Blackberry JDE	XCode	Eclipse Plug-in	Visual Studio	Visual Studio

Regulatory compliance: To regulate the flood of new medical services in mHealth, the Federal Communications Commission (FCC) and the Food and Drug Administration (FDA) claim jurisdiction over mobile devices in healthcare. The FCC must approve all upcoming mobile devices before they can be released; while the FDA must approve all medical devices before entering the market. Other healthcare regulations, such as HIPPA, also need to be taken into consideration during any deployment of mHealth devices.

Regardless of the challenges facing it, the numerous opportunities and medical benefits that the mobile platforms offer will be refined and will provide many advantageous solutions to doctors and patients. The new platforms are significantly shifting and improving the quality, convenience and accessibility of healthcare.

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Interactive Mind-Driven Rehabilitation

The combination of virtual reality and Brain-Computer Interface has demonstrated a new future for rehabilitation. With the development of these technologies, rehabilitation training will be more controllable.

By Zheng Xiaoxiang

Active rehabilitation is a new but widely recognized solution for patients with neurological disorders. In active rehabilitation, patients perform actively in training therapy to ensure the optimal rehabilitation outcome. The key of the solution lies in the active initiation and execution of movements of the limbs by highly intensive training in meaningful environments in order to achieve optimal recovery. Amongst the various approaches of active rehabilitation, the idea of "mind-driven" rehabilitation is very new. In the "mind-driven" approach, a user controls an actuator with his/her thoughts so that the patient is trained with their own intention mostly focused on the training progress, thus gaining a better recovery.

Figure 1: A subject uses a VR system to actively engage in rehabilitation. The combination of VR and Brain-Computer Interface has demonstrated a new future for rehabilitation.

To realize "mind-driven" more effectively, an interactive user interface is essential. Virtual Reality (VR) is one of the best choices for its interactive components and variety, both in motor function restoration and in space and cognitive ability recovery training. First, research indicated that patients could modulate operations, such as moving, grasping and releasing virtual objects, through visual, auditory, tactile and olfactory feedback in virtual environments. Distinct improvements of hand dexterity and movement control ability are detected after training. The movement skills patients picked up in the virtual environments will be retained in the real-life world. Second, a 3D interactive immersive environment provided by VR inspires and maintains training motivation. Last but not least, introduction of VR in rehabilitation helps establish online feedback and real-time quantitative estimation of function restoration.

Currently, Qiushi Academy for Advanced Studies of Zhejiang University (QAAS, Hangzhou China) is building an interactive mind-driven rehabilitation system. In order to achieve the goal of optimal rehabilitation, three components are needed to make the "interactive," "mind-driven" system fully functional – user intention decoder, interactive environ-

continued on page 12

Product Comparison Chart:
Handhelds and Mobile Health Services

With the growing popularity of the iPhone, more and more consumers are being exposed to the mobile health world. Handhelds and mobile health services have the ability to revolutionize the way we view and practice health-care. With new products and software literally at their fingertips, patients and doctors alike can benefit from the ways in which care will become more streamlined and efficient. From a simple text message reminder for medication to an implanted device delivering pre-measured doses of a drug, the possibilities in this field are endless.

DEVICE	DESCRIPTION OF PRODUCT	MANUFACTURER
HouseCallPlus	remote patient monitoring system	St. Jude Medical
Epocrates	provides drug information on drug interactions, pill identification, peer-reviewed disease management content for on-site diagnosis	iPhone application
iMAT-Mental Armor Training	enhances soldiers' abilities to form accurate interpretations of the events they experience during deployment and in every day life	iPhone application/Virtual Reality Medical Center
mCare	mobile application that facilitates two-way communication with doctors and patients-report changes in mood swings/sleeping behaviors	AllOne
CardioMEMS wireless HF sensor	miniature implantable sensors use radiofrequency to transmit patient data to help manage congestive heart failure	CardioMEMS, Inc.
Caalyx AAL	prototype consisting of mobile roaming monitoring system and a caretaker center; monitors vital signs at all times, alerts to falls	Caalyx
Cardiomessenger	external device resembling cell phone receives data from an implanted device and forwards information to service center	BIOTRONIK
QuestCare360	HIPAA-compliant e-prescribing drug applications, users can view medication history, lab results etc. on the go	iPhone application
Mobile Cardiac Outpatient Telemetry (MCOT)	cardiac monitoring service with beat-to-beat, real time analysis, automatic arrhythmia detection and wireless ECG transmission, transmits data directly from patient to physician to constantly monitor the heart	CardioNet
Skyscape Medical Resources	mobile medical information and decision support tools, drug guide, medical calculator, information on disease symptoms and topics	iPhone application
Health Hero	telehealth platform to support remote health monitoring and management programs	Bosch
Quiet Care	remote monitor system for seniors, alerting caregivers to changes that may signal potential health issues or emergency situations such as a fall or emerging health problem	GM
VR Pain Management System	virtual reality pain distraction system consisting of software products with novel stimuli that guide patients to reduce pain and anxiety	Virtual Reality Medical Center
Implanted glucose monitor	discreet, long-term implanted monitor with alerts and alarms designed to wirelessly deliver continuous glucose measurements	MicroCHIPS
iStethoscope Pro	phone works as stethoscope to gauge heartbeat, help to diagnose problems and potential abnormalities in heartbeat	iPhone application

Wounds of War II: Coping with Posttraumatic Stress Disorder in Returning Troops

EDITED BY:
Professor Dr. Brenda K. Wiederhold, Ph.D., MBA, BCIA

WOUNDS OF WAR II: COPING WITH POSTTRAUMATIC STRESS DISORDER IN RETURNING TROOPS

On October 18-21, 2009 the NATO Advanced Research Workshop 'Wounds of War II: Coping with Posttraumatic Stress Disorder in Returning Troops drew 30 eminent experts from 14 countries to discuss the impact of war-related stress on participants from current and past conflicts, particularly when it results in increased risk and incidence of PTSD. Held in Klopeiner See, Südkärnten, Austria at the Hotel Amerika-Holzer, discussion topics included increased PTSD as a result of missions, as well as how PTSD may be prevented. Often thought of as an "invisible wound of war," PTSD may manifest in very visible ways, affecting behavior, relationships and society. The ultimate aim of the workshop was critical assessment of existing knowledge and identification of directions for future actions. The co-organizers of this workshop alongside Professor Brenda K. Wiederhold included Professor Kresimir Cosic and Professor Dragica Kozaric-Kovacic of Zagreb, Croatia and Colonel Carl Castro from the United States.

Full papers are being published by IOS Press

PRE-PUBLICATION: $70

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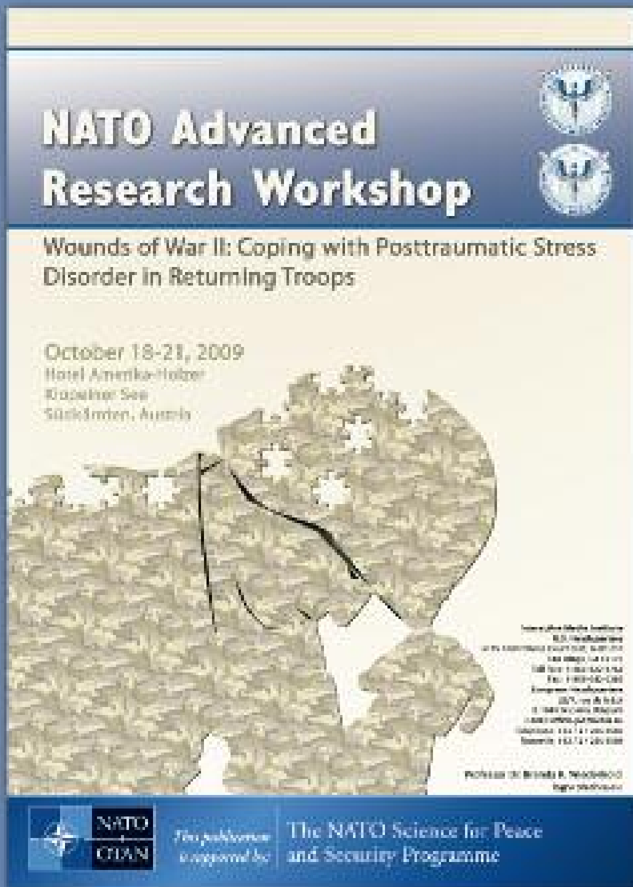

The post-conference book reflects the key topics discussed in the five sections at the workshop:

First Session – Vulnerability

Second Session – Diagnosis and Assessment

Third Session – Training and Treatment

Fourth Session – Technology-Based Training and Treatment

Fifth Session – PTSD and Comorbidity

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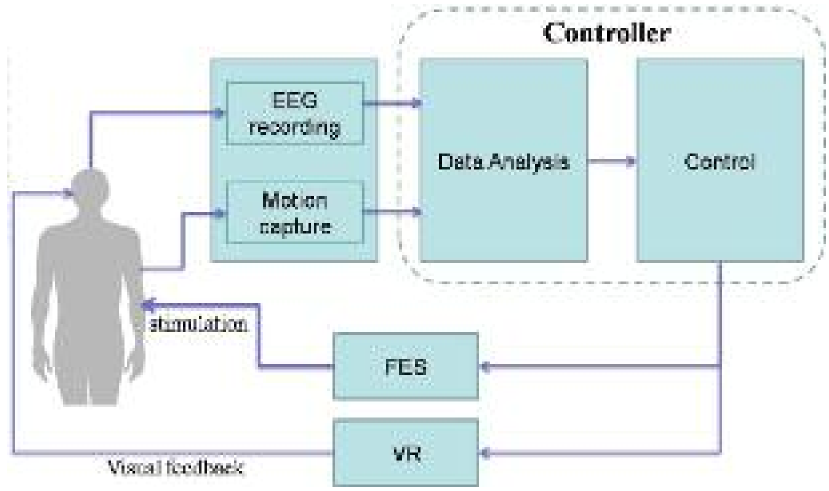
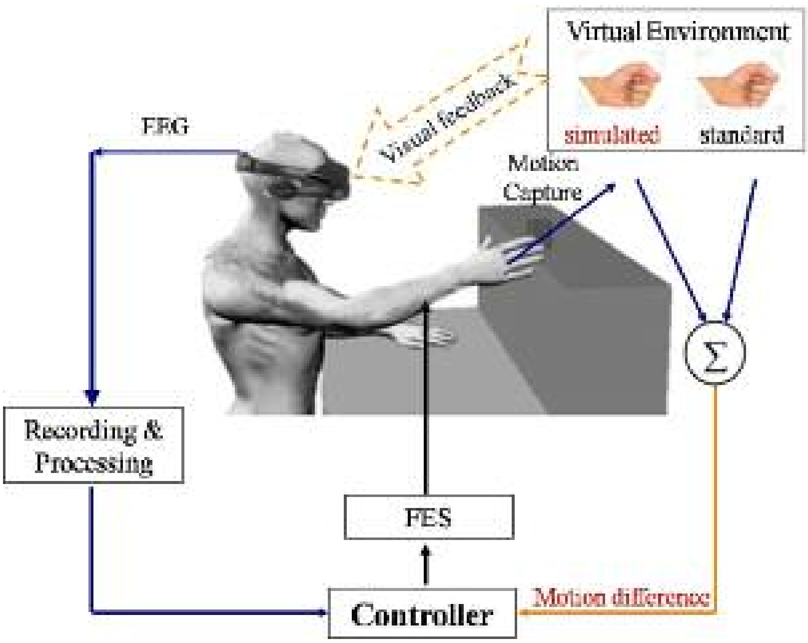
ment and actuator. An interactive environment is the key to the system in that it's the platform where rehabilitation training takes place, the user intention decoder detects the user's subjective intention and interprets it into control signals and the signals are then fed into the actuator to improve patients performing. QAAS chose to use Brain-Computer Interface (BCI), VR and functional electrical stimulation (FES) as the abovementioned three components respectively.



VR as the interactive environment provides two things – one is a supervisor which indicates the training task the user needs to conduct, the other is the realtime feedback of the current status of the body part being trained. The current motion is picked up by sensors in the form of a goneometer, accelerometer, data glove or cameras. A VR platform sends online data of movement status to FES so it can adjust assistant intensity and pattern accordingly. In the meantime, VR records the user's performance statistics during the whole training session for rehabilitation evaluation. BCI in QAAS' system is used to detect the user's movement-related brain signals from scalp Electroencephalogram (EEG). Considering the fact that patients' EEG could be different from healthy people (especially in the case of stroke-afflicted patients), the BCI is designed to detect not only the EEG components related to motion activity, but also the planning or even mind intention for non-specific movement. The FES system, the actuator, conducts activities initiated by the commands from BCI and adjusted by feedbacks from VR.

In training, motion targets appear randomly in the VR interface, toward which patients are supposed to move the limb. After the BCI detects that intention, it starts the FES system to assist the limb movement. The interaction loop between VR and FES would insure an accurate adjustment of this movement and help patients reach toward the target. Once the difference between real movement and intended task reaches below a threshold, a round of training is considered to have been accomplished. This process repeats itself during the whole training session.



The ultimate aim of this technology is to enable patients to use their own mind with the help of actuators via enhanced VR to play games, cook, learn and live on their own. The combination of VR and BCI has demonstrated a new future for rehabilitation. With the development of these technologies, rehabilitation training will be more controllable. The famous movie "Matrix" shows us a distant (but not remote) future of BCI. Today we can use VR and some actuator equipments such as FES to realize the wishes of the brain. Patients no longer need to go to hospital for rehabilitation training. Rather they can easily finish all the work at home with the help of a personal computer. Drawing on the advancement of the Internet, people will be able to build a community of virtual rehabilitation online, and those who have unfortunately lost self-care abilities can regain them through interactive mind-driven rehabilitation. VR, BCI and other technologies possess infinite possibilities for rehabilitation.

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The Decade of the Handheld:

Optimizing Outcomes for the Handheld Generation

By Linda A. Jackson & Alex Games

You see them here. You see them there. It seems you see them everywhere. Sometimes they're held against the ear, sometimes they're attached to it. Sometimes they're held at arm;s length, which seems to trigger rapid activity in both thumbs against a tiny keyboard. Other times holding them at arm's length seems to focus the user's attention on the tiny little screen they possess, often evoking emotional reactions to what is happening on that screen. Some can take pictures and save them for you. Some can help you find your way around town. Most make noises¬–funny noises, pleasant noises and downright irritating noises. These noises often cause others to look around with annoyance for the source of the noise, making clear by facial expression alone that the noise is unwelcome and should be stopped, immediately. Welcome to 2010. Welcome to the decade of the cell phone, text messenger, iPod, blackberry or any one of a number of devices we will collectively call in this article the "handheld."

What do we know about handhelds? Judging from a Google search entering the word "handhelds" on December 20, 2009, we apparently know quite a lot–12,800,000 Web sites deal in one way or another with handhelds. A mere 9,500,000 deal with cell phones. On the other hand, if we search psychological literature for professional research articles such as PsychINFO with the word "handheld," that number plummets to 14. Change the target word to "cell phones" and we're a bit better off. Sixty-one research articles address cell phone effects. Thus, we are sorely in need of research on the psychological effects of using handhelds, which include their social, cognitive, moral and behavioral effects. Our knowledge of the psychological effects on children, the sure-to-be handheld generation, is abysmally limited.

A brief look at the statistics on handhelds prompts urgent questions about their psychological effects. In June 2009, wireless penetration reached 89% of all U.S. households, compared to 34% in June 2000. According to the Wireless Association, a professional organization that has tracked wireless activities for the past 25 years, the annualized total wireless revenues in 2009 was $151.2 billion compared to $45.3 billion in 2000. Monthly SMS (short message system) activity, commonly known as text messaging, increased from 12.2 million in 2000 to 135.2 billion in 2009. Corresponding to this change, the annualized minutes of cell phone use increased from 194.95 billion in 2000 to 2.23 trillion in 2009.

The shift to wireless technology is not a U.S. phenomenon. It is a global trend evident in all of the developed world and in much of the developing world. More and more applications that once required a clunky computer or portable but heavy laptop are migrating to the handheld world. Already the handheld has encompassed the most popular information technology (IT) applications for adults – the Internet and e-mail. Handhelds began as cell phones, which remains their primary use, but text messaging (SMS) is increasing by leaps and bounds, especially among the under-30 crowd. Most cell phones now also have cameras and many have a global positioning system (GPS) that is as sophisticated as a standalone GPS. And much to the delight of the under, under-30 crowd, the tweens or teens and young adults, videogames are quickly becoming part of the handheld world. For the right price you can indeed have the world at your fingertips.

The two most studied IT applications of greatest interest to children that have migrated to the handheld world are videogames and cell phones, including the text messaging and picture-taking features of cell phones. Interdisciplinary teams of researchers have been addressing the question of what effects, if any, videogame playing and cell phone use have on children. Thus far, more progress has been made on videogame effects than on cell phone effects. Videogame playing in adults has been causally related to visual-spatial skills and correlated with these skills in children. Visual-spatial skills are viewed by many developmental psychologists as the "training wheels" for later performance in science, technology, engineering and mathematics, however, stronger evidence exists for a negative relationship between videogame playing and psychological outcomes. Children who play videogame more have more aggressive cognition, aggressive behavior, poorer academic performance, more negative teacher ratings of classroom behavior and greater body weight than a comparable sample of non-players. To date, no distinctions have been made in the literature as to whether the mode of videogame delivery is over the Internet, through a console or by way of a cell phone, although the commercialization of videogames suggests that the console is currently the most popular mode of videogame delivery.

Conspicuously absent in the developmental and IT literature is research on cell phone correlates and effects on children. As of 2007, the global cell phone market contained approximately 1.8 billion subscribers. It is forecasted to reach three billion by the end of 2010, at which time nearly half of all human beings on earth will have and use a cell phone. Although voice calls currently account for about 80% of cell phone revenue, the short message service (SMS), or text messaging, is becoming extremely popular, particularly among the under-30 crowd. In fact SMS is expected to dominate mobile messaging in both traffic volume and revenue by the end of this decade. SMS is a favored mode of communication among youth who have access to cell phones

What we need to do now for children of the handheld generation is to determine how to maximize the good and minimize the bad potential effects that come with every technology innovation.

The lack of research on cell phone use effects on children may be partly attributable to its lower adoption by this age group than other forms of IT such as videogames, but the age at which children receive their own cell phones keeps dropping and the time to ascertain effects, good or bad, is now. On the positive side, cell phones used as communication devices have the potential to increase social connectedness and even improve parent-child relationships with the responsible use of the cell phone by both. On the negative side, there is the potential for cell phone use to increase social isolation as more and more time is devoted to text messaging and less and less time to face-to-face interaction, with family, friends and acquaintances. The effects of videogame availability on cell phones raises yet another set of important research questions in child development. The benefits and liabilities of the handheld vidoegame may depend on child characteristics and perhaps even parent characteristics, which will need to be clarified in future research. At this time the best that can be said for cell phone use is that it facilitates social connections, including connections with parents, which may outweigh any negative effects in face-to-face social communication. Indeed, some research shows that youth use cell phones primarily to connect with existing real-world social networks to strengthen connections among members.

Handhelds are not the way of the future – they are here now and here to stay until the next wave of technology innovations renders functions too slow, too demanding or simply inadequate. What we need to do now for children of the handheld generation is to determine how to maximize the good and minimize the bad potential effects that come with every technology innovation. The ease and enjoyment with which children use handheld devices begs for research on the development of games that foster learning, especially learning in science, technology, engineering and mathematics (STEM areas). A newborn, an infant, a toddler and a preschooler learn by playing. Why should it be otherwise in the K-12 child. We and our colleagues, Jing Lee, at Syracuse University, and Yong Zhao, also at Michigan University, intend to experiment with learning STEM areas wrapped in nanotechnology concepts using handheld devices programmed to resemble computer games. Our hope is that learning will be as natural an outcome of playing as it is in the early years, when we learn an entire language, categorization and socialization, among other complex concepts. We would like to encourage others to join in the search.

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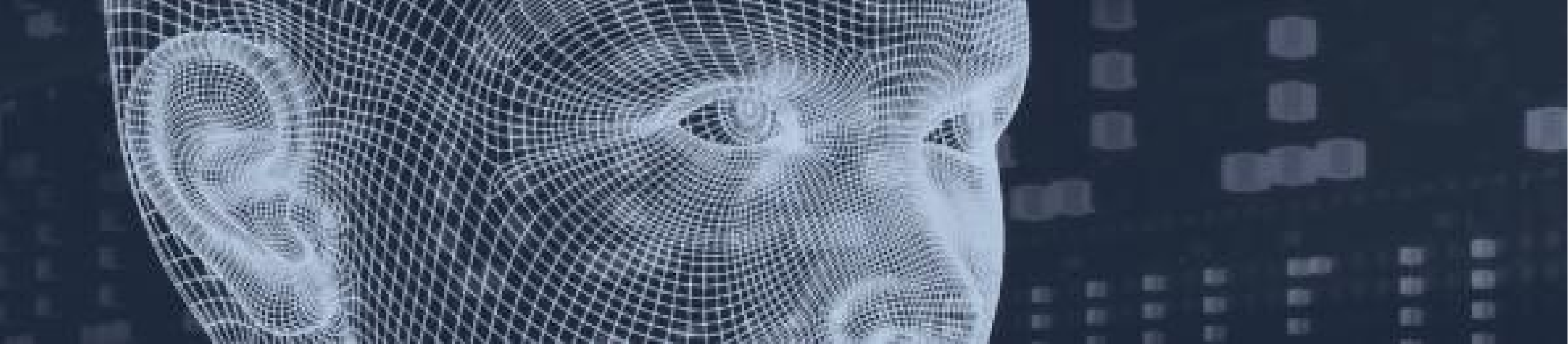

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Virtual Reality in Eating Disorders and Obesity

This review describes how virtual exposure was used to improve the negative emotions related to food and the body in subjects with obesity and eating disorders. With the aid of a therapist, they learned how to better deal with the negative emotions and in turn, to develop healthier behaviors.

By Giuseppe Riva & Enrico Molinari

Different new technologies have been introduced over the last few years that are increasingly finding application in health care delivery for patients with eating disorders and obesity. These include self-help (supervised and unsupervised), telemedicine, telephone therapy, e-mail, Internet, computer software, CD-ROMs, portable computers, and virtual reality techniques. One of the most promising is virtual reality (VR), an advanced form of human-computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic fashion.

Distorted body image, negative emotions and lack of faith in the therapy are typical features of these disturbances and are the most difficult characteristics to change. One innovative approach to their treatment is to enhance traditional cognitive-behavioral therapy (CBT) with the use of virtual reality.

A first approach is the one offered by the Experiential Cognitive Therapy (ECT). Developed by Giuseppe Riva and his group inside both the IVT2010 Italian Government funded project and the VEPSY Updated European funded project is a relatively short-term, patient oriented approach that focuses on individual discovery. IET shares with the Cognitive Behavioral Therapy (CBT) the use of a combination of cognitive and behavioral procedures to help the patient identify and change the maintaining mechanisms. However it is different for:

- Its use of Virtual Reality (VR): 10 VR sessions are part of the standard protocol.
- Its focus on the negative emotions related to the body, a major reason patients want to lose weight.
- Its focus on supporting the empowerment process. VR has the right features to support empowerment process, since it is a special, sheltered setting where patients can start to explore and act without feeling threatened.

During the VR sessions (see Figure 1) they use the "20/20/20 rule." During the first 20 minutes, the therapist focuses on getting a clear understanding of the patient's current concerns, level of general functioning, and their experiences related to food and to the body. This part of the session tends to be characterized by patients doing most of the talking, although the therapist can guide with questions and reflection to get a sense of the patient's current status. The second 20 minutes is devoted to the VR experience. During this part of the session the patient enters the virtual environment and faces a specific critical situation such as a kitchen, supermarket, pub, restaurant or gymnasium. Here, the patient is helped in developing specific strategies for avoiding or coping with the negative emotions induced by the situation. In the final 20 minutes the therapist explores the patient's understanding of what happened in VR and the specific reactions – emotional and behavioral – to the different situations experienced. If needed, some new strategies for coping with the VR situations are presented and discussed. To support the empowerment process, the therapists follow the Socratic style – they use a series of questions related to the contents of the virtual environment to help clients synthesize information and reach conclusions on their own.

The different virtual scenes are included in an open source virtual environment – NeuroVR – that can be downloaded for free from the NeuroVR Web site: http://www.neurovr.org. Using this software the therapist may also customize each environment by adding significant cues such as images, objects, and video related to the story of the patient.

This approach was validated through different case studies and trials. In the first one, uncontrolled, three groups of patients were used – patients with Binge Eating Disorders, patients with Eating Disorders Not Otherwise Specified, and obese patients with a body mass index higher than 35. All patients participated in five biweekly sessions of the therapy. All the groups showed improvements in overall body satisfaction, disordered eating, and related social behaviors, although these changes were less noticeable in the Eating Disorders Not Otherwise Specified group.

More recently, the approach was tested in different controlled studies. The first one involved twenty women with Binge Eating Disorders who were seeking residential treatment. The sample was assigned randomly to ECT or to CBT based nutritional therapy. Both groups were prescribed a 1,200-calorie per day diet and minimal physical activity. Analyses revealed that although both groups were binge free at one-month follow-up, ECT was significantly better at increasing body satisfaction. In addition, ECT participants were more likely to report increased self-efficacy and motivation to change.

In a second study, the same randomized approach was used with a sample of 36 women with Binge Eating Disorders. The results showed that 77% of the ECT group quit bingeing after six months versus 56% for the CBT sample and 22% for the nutritional group sample. Moreover, the ECT sample reported better scores in most psychometric tests including EDI-2 and body image scores.

In the final study, ECT was compared with nutritional and cognitive-behavioral treatments, using a randomized controlled trial, in a sample of 211 female obese patients. Both ECT and cognitive-behavioral treatments produced a better weight loss than the nutritional treatment after a six-month follow-up. However, ECT was able to significantly improve, over nutritional and cognitive-behavioral treatments, both body image satisfaction and self-efficacy. This change produced a reduction in the number of avoidance behaviors as well as an improvement in adaptive behaviors.

Figure 1: A patient undergoes experiential cognitive therapy.

A second approach was investigated by the Spanish research group led by Cristina Botella. Her group compared the effectiveness of VR to traditional Cognitive Behavior Treatment for body image improvement (based on the protocol developed by Cash) in a controlled study with a clinical population. Specifically, they developed six different virtual environments, including a 3D figure whose body parts (arms, thighs, legs, breasts, stomach, buttocks, etc.) could be enlarged or diminished (see Figure 2). The proposed approach addressed several of the body image dimensions – the body could be evaluated wholly or in parts, the body could be placed in different contexts, for instance, in the kitchen, before eating, after eating, facing attractive persons, etc., behavioral tests could be performed in these contexts, and several discrepancy indices related to weight and figure could be combined such as actual weight, subjective weight, desired weight, healthy weight, how the person thinks others see her/him, etc.

In the published trial eighteen outpatients, who had been diagnosed as suffering from eating disorders (anorexia nervosa or bulimia nervosa), were randomly assigned to one of the two treatment conditions – the VR condition (cognitive-behavioral treatment plus VR) and the standard body image treatment condition (cognitive-behavioral treatment plus relaxation). Thirteen of the initial 18 participants completed the treatment. Results showed that following treatment, all patients had improved significantly. However, those who had been treated with the VR component showed a significantly greater improvement in general psychopathology, eating disorders psychopathology, and specific body image variables. Since then, the group has also developed a VR simulator of food and eating currently under evaluation with patients. A final approach was proposed by the Spanish research group led by Gutiérrez-Maldonado. This group investigated the emotional potential of food-related VR experiences with eating disordered subjects. In a first study, thirty female patients with eating disorders were exposed to six virtual environments – a living-room (neutral situation), a kitchen with high-calorie food, a kitchen with low-calorie food, a restaurant with high-calorie food, a restaurant with low-calorie food, and a swimming-pool. After exposure to each environment the researchers evaluated the level of state anxiety and depression experienced by the sample. In a recent study, the response to the same five experimental virtual environments plus a neutral room in a group of eighty-five eating disordered subjects was compared with a control group of students. Results of several repeated measures analyses demonstrated that patients show higher levels of anxiety and a more depressed mood after exposure to high-calorie food and after visiting the swimming pool than in the neutral room. In contrast, controls only show higher levels of anxiety in the swimming pool.

Overall, these results show that virtual environments are particularly useful for simulating everyday situations that may provoke emotional reactions such as anxiety and depression, in clinical patients. Specifically, the virtual experiences in which subjects were

Published studies related to the use of VR in obesity and eating disorders (source Medline, accessed November 17, 2009)

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Emmelkamp PM., Technological innovations in clinical assessment and psychotherapy, *Psychother Psychosom.* 2005;74(6):336-43. Review.
Myers TC, Swan-Kremeier L, Wonderlich S, Lancaster K, Mitchell JE., The use of alternative delivery systems and new technologies in the treatment of patients with eating disorders, *Int J Eat Disord.* 2004 Sep;36(2):123-43. Review.
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Perpiña C., Botella C., Baños RM., Virtual reality in eating disorders, *European Eating Disorders Review* 2003;11(3):261-278.
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Perpiña C, Botella C, Baños RM, Marco JH, Alcañiz M, Quero S., Body image and virtual reality in eating disorders: Exposure by virtual reality is more effective than the classical body image treatment? CyberPsychology & Behavior 1999;3(2):149-159.
Riva G, Bacchetta M, Baruffi M, Rinaldi S, Molinari E.,Virtual reality based experiential cognitive treatment of anorexia nervosa, *J Behav Ther Exp Psychiatry.* 1999 Sep;30(3):221-30.
Riva G, Bacchetta M, Baruffi M, Rinaldi S, Molinari E., Experiential cognitive therapy in anorexia nervosa. *Eat Weight Disord.* 1998 Sep;3(3):141-50
Riva G. , Modifications of body-image induced by virtual reality., *Percept Mot Skills.* 1998 Feb;86(1):163-70.

forced to ingest high-calorie food induced the highest levels of state anxiety and depression.

In conclusion, the data available on scientific journals (see Table 1) suggest that VR can help in addressing two key features of eating disorders and obesity not always adequately addressed by existing approaches – body experience disturbances and self-efficacy. VR technology offers an innovative approach to the treatment of body image disturbance, a difficult concept to address in therapy. Previously, cognitive-behavioral and feminist approaches have been the standard interventions, although in our experience, it seems that many patients continue to struggle with negative body image post-treatment.

Second, as emphasized by social cognitive theory, performance-based methods are the most effective in producing therapeutic change across behavioral, cognitive, and affective modalities. The proposed experiential approaches could help patients in discovering that difficulties can be defeated, so improving their cognitive and behavioral skills for coping with stressful situations related both to food and to their body.

Finally, the papers published by the Gutiérrez-Maldonado group suggest that VR may be useful, too, for simulating everyday situations to assess emotional reactions in clinical patients.

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VR Lab Provides Relief for Warriors and Their Families

Tripler Army Medical Center Uses Next Generation Treatments for Stress and Pain

By Melba C. Stetz et al.

It is estimated that 3-15% of deployed war fighters involved in current conflicts are affected by posttramatic stress disorder. New studies show promising signs that virtual reality may be able to help.

The National Institute of Mental Health reports that over five million individuals in the United States suffer annually from stress. In 2007, the American Psychological Association conducted a survey study. Specifically, many participants reported experiencing psychological symptoms related to stress as anger (50 %), nervousness (45 %). low energy (45 %), and wanting to cry (35 %). It is also estimated that stress in the form of posttraumatic stress disorder, for example, impacts 3-15% of deployed war fighters involved in the current conflicts. About one out of every 10 veterans from Operation Iraqi Freedom/ Operation Enduring Freedom (OIF/OEF) might suffer some type of stress disorder. Coming back from the battle-zone with a combat-stress diagnosis might facilitate access-to-care and potential financial benefits. In fact, a study on OIF veterans suggested that about one-third of those that received care from 2001 to 2005 were diagnosed with general mental health or psychosocial problems. That said, being diagnosed with combat stress problems also involves a spillover of other problems that impact the readjustment to life out of the battle-zone.

Mental Health help in the Battlezone

The U.S. military is currently a voluntary force. Some individuals join to follow a family tradition, to seek an adventure, to show patriotism, such as joining after 9/11, and even to avoid jail.

Nevertheless, the U.S. military can be a very stressful organization. It imposes rigid rules and expectations. The rationale behind this modus operandi is that, in the moment of truth, an automatic "right" decision can make the difference between life or death.

Psychotherapy can have positive outcomes for a war fighter, but also casts a shadow of negative social outcomes. War fighters who experience combat stress symptoms such as hypervigilance and nightmares end up without many options. They can live in denial trying to avoid their worst memories, or seek help. If a warrior wants help, she or he will likely have to ask supervisors for time to see a doctor, making public their inner feelings of vulnerability.

In the battle-zone, this truth can be even worse. A war fighter identified as "having mental problems" will probably have to be removed from the battle-zone if not treated on site. If treated on site, she or he might restricted from carrying a weapon. The individual might be asked to do things differently from peers, such as sleep in a specific area under supervision, remove the bolt from the weapon or other actions. In addition to the potential stigma, getting psychological help is a "luxury." There are not enough mental health providers or vehicles to take patients back and forth from sessions or meetings.

Figure 1. Mental Health Specialist (SGT Meyers) simultaneously monitor (a) what a participant sees via an HMD as well as (2) his stress marker's levels.

While deployed to OIF, the author, Stetz, surveyed deployed warriors to learn that their preferred forms of relaxation were listening to music (65%), watching movies (62%), and playing computer games (39%). In consonance with previous studies, these individuals reported preferring to chat with peers, chaplains, and military leaders about personal difficulties rather than go to therapists.

Therapies for the Digital Generation of Warriors

One of the preferred methods to help war fighters in distress involves cognitive-behavioral therapeutic approaches. A prized technique is called "imaginal" exposure. Patients repeatedly imagine their worst traumatic event(s) in therapy to habituate to the mental and emotional experience. The pairing of autonomic arousal with recounting of stressful memories is then followed by relaxation, with the hope that reduction of associated psychosocial impairments will be mitigated. Another technique is called "in vivo" exposure. In these sessions, individuals are placed in situations that they find stressful, such as facing a crowded marketplace. Most clinicians add positive coping strategies in the form of progressive muscular relaxation and controlled breathing in these sessions. The goal with these approaches is to help the client to re-engage in their daily living activities. Nevertheless, imaginal exposure cannot be effective if the patient has problems imagining things. Similarly, while in vivo exposure does not depend on imagination, it can risk further distress when exposing clients to situations that they want to avoid.

Interestingly, the U.S. Army has recently released a new Field Manual "Training for Full Spectrum Operations." This manual explicitly references technology and gaming as a needed military tool. Considering the stigma that war fighters and shortcomings with current therapeutic approaches, virtual reality (VR) seems to be a keystone point between all roads. That is, there is no need to depend directly upon imagination or to risk exposing a patient to a traumatic stressor. It can also present immersive environments that can be experienced simultaneously by both the therapist/researcher and the individual in need. Furthermore, stimuli can be presented within a measured and successive manner to suit treatment goals.

Virtual Reality at Tripler Army Medical Center

Tripler Army Medical Center's Department of Psychology is considered a "Center of Ex-

Figure 2. Research Assistants (Koliani and McDermott) test one of the VR systems to be used during a cystoscopy session.

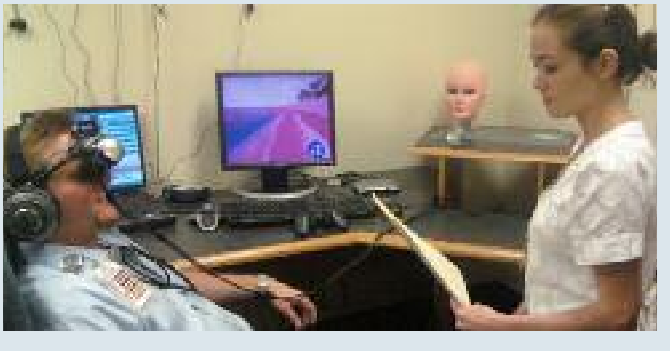

Figure 3. Research Fellow Ries (author), and RA Kaloi-Chen testing the VR system and relaxation script for a chronic pain session.

cellence in Professional Psychology" servicing the Pacific Region. It offers psychology services to help the local community and offers top-rated training experiences to develop the new generation of mental health professionals. Considering the above-mentioned stigma experienced by many war fighters and their attraction to computers and videogames, this department has launched several VR clinical research projects.

Preliminary data from one of these VR studies (see Figure 1) suggests deeper immersion when wearing a head mounted display (HMD). That is, participants that watched videos of angry bosses yelling at them had higher levels of subjective "presence" and emotional reactivity than those watching the videos on a flat screen. In another study, anecdotal data suggests effective pain distraction by VR for the urology patients that played a videogame while wearing a HMD (Figure 2). Similarly, chronic pain patients involved with another study are reporting more distraction/ immersion when using HMDs to play a relaxing game while listening to relaxation scripts (Figure 3).

As evidenced by studies such as these, embracing the values presented by VR mental health technology can unfurl a wide range of possibilities, offering broader access to self-care adjuncts and psychotherapy tools. New explorations of applications for VR in mental health portend fruitful growth in psychology-related fields and new frontiers for individuals' healing.

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Transcranial Doppler Monitoring in Presence Research

In this study, presence is measured in patients exposed to virtual environments using a method implementing non-invase brain monitoring.

By Beatriz Rey et al.

In order to study the psychological mechanisms underlying experiences in virtual environments (VE), one of the concepts that are analyzed is presence. A commonly accepted definition of this concept indicates that presence is the subjective experience of being in one place, even when you are physically located in another.

One of the possible indicators of presence that have been proposed is neurological activity. Brain activity measures are promising because they potentially provide data that is not influenced by the participant's interpretation. However, the analysis of these measures can be difficult since very little is known about the neural processes that are involved in the complex experience of presence. The brain activity measures that have been proposed for presence research are the electroencephalogram (EEG) and the functional magnetic resonance imaging (fMRI).

An alternative brain activity measurement technique has been proposed recently: Transcranial Doppler Monitoring (TCD).

Transcranial Doppler Monitoring

TCD is a technique of diagnosis by ultrasound. It requires two probes to be placed on the head of the subject using a headband or a similar object. It allows us to directly register the information of blood flow velocity from the Middle Cerebral Artery (MCA), Anterior Cerebral Artery (ACA) and Posterior Cerebral Artery (PCA). The probe direction, the reference volume depth and the flow direction identify each cerebral artery.

TCD has important advantages when compared to other techniques. First of all, it has a high temporal resolution, which allows instantaneous monitoring of cerebral responses to specific events. Furthermore, it is non-invasive, so it is possible to use it in an ecological way in a great variety of environments. That constitutes its main advantage when compared with other techniques such as fMRI. The main disadvantage of TCD is its spatial resolution, which is limited by the size of the cortical areas supplied by the arteries under study.

TCD has been widely used to monitor cerebral hemodynamics during the performance of cognitive tasks in psychophysiological research. These studies have shown that mean BFV obtained from TCD signals increases when users are doing a cognitive activity when compared to baseline periods.

TCD and Presence

We have used TCD to analyze cognitive states related with presence during the exposure to VE in different immersion and navigation conditions.
In the first study, two different navigation conditions were compared (user-controlled vs. system-controlled navigation). The percentage variations between baseline and navigation were positive in all the arteries under study (MCAs and ACAs). Significant differences occurred only in the left arteries. The variations in MCA-L could be due to the motor tasks with the right hand to control the joystick. However, the variations in ACA-L can only be explained by other factors such as differences in the emotional state or the level of presence that the user is experiencing during the VE exposure in the different navigation conditions. Presence questionnaires confirmed that the level of presence was different between experimental conditions.

The second study compared the same navigation conditions but in two different immersion configurations (CAVE-like vs. projection screen). In this case, only MCAs were considered. The navigation factor had significant influence in BFV variations in both MCA.

Figure 1. Screen capture of the virtual environment used in the experiments.

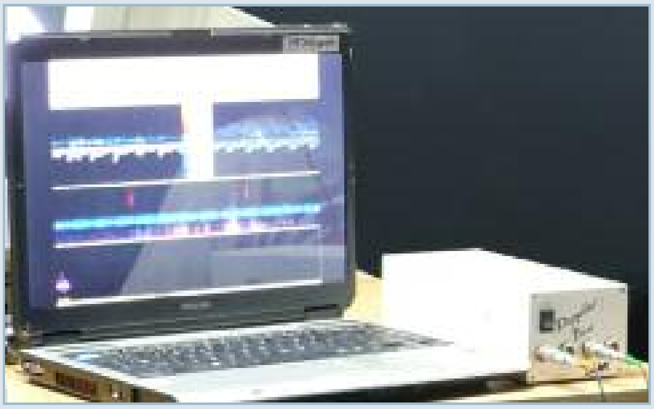

Figure 2. The Transcranial Doppler unit used in the experiments (Doppler-Box Compumedics Germany GmbH) is connected to a PC in which BFV signal can be visualized.

Discussion

The studies that have been described show that it is possible to use TCD monitoring during exposure to VE. TCD is a tool that can be easily integrated in VR settings to monitor brain activity during the VR experience, so it is possible to obtain reliable TCD signals during the exposure to VE. On the other hand, the use of TCD does not interfere with the capability of the subjects to focus their attention on the VE.

Further research may contribute to discern the role of each variable in the differences in the blood flow velocity that have been observed in these studies.

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Surgery Simulation:

Training Tool of the Future

The advantages of teaching surgery using virtual reality simulations provide motivation to further develop this field. In the following article, the authors describe methods they have implemented to make this training tool more realistic and efficient for training surgeons.

Shiyu Jia & Zhenkuan Pan

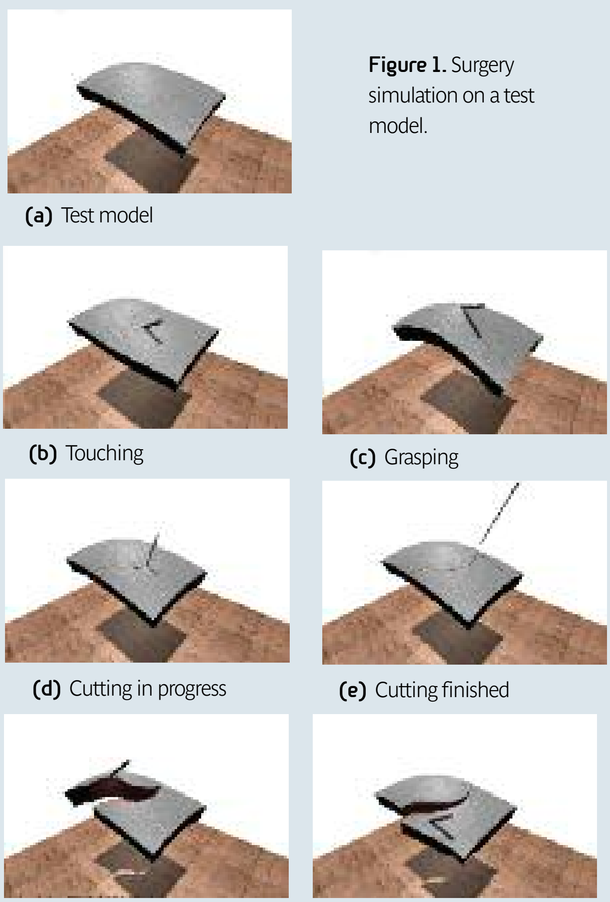

Figure 1. Surgery simulation on a test model.

(a) Test model

(b) Touching

(c) Grasping

(d) Cutting in progress

(e) Cutting finished

(f) Opening cutting wound by grasping

Surgery simulation simulates surgery processes in a computer-generated virtual environment. It is an application of virtual reality technologies in the field of medicine. Non-real-time surgery simulations are usually used for surgery planning while real-time surgery simulations are used for surgery training. Compared to conventional surgery training methods, such as using corpses and dummies, real-time surgery simulation is more cost-effective, can be more immersive and interactive, can be repeated unlimited times without any real harm, and can easily adapt to different physiological parameters of different patients. Our research focuses on designing and implementing mathematical models and algorithms for real-time surgery simulation, including deformation of deformable objects, user interaction with haptic devices and simulating surgical operations such as cutting.

We have developed a surgery simulation software system using C++. The system is composed of several modules, including user interface, a graphics renderer, haptic device manager, collision detection, deformation calculation, cutting tool, touching and grasping tool. The system is designed to be multi-threaded, and thus can take advantage of multi-CPU or multi-core CPU. Graphics rendering is implemented using OpenGL 2.0 with GLSL shaders and currently PHANToM haptic devices from SensAble Technologies are supported using GHOST SDK. The haptic update loop is implemented in a separate thread to decouple it from collision detection and deformation calculation.

To facilitate algorithm implementation, we designed a sophisticated data structure to store geometrical, topological and mechanical information of a target object. The object is represented by tetrahedral mesh. The mesh is composed of vertices, edges, triangular faces and tetrahedrons. Each element has relational information about its neighboring elements. For example, each edge has two pointers pointing to its two vertices and a list of pointers pointing to tetrahedrons that contain this edge. Each tetrahedron also stores mechanical properties such as density, Young's modulus and Poisson's ratio.

Detecting collisions between surgical tools and the target object is the first step of interaction. We use AABB tree for the target object. Since the object can deform, the AABB tree needs to be updated in real-time. To reduce computational cost, a top-down updating algorithm is implemented. Each AABB is enlarged by a small amount so that updating is not needed if all the vertices still lie within its bound. The touching and grasping tool is treated as a point while the cutting tool is treated as a line segment. Once collision is detected, the penetration depth is used for calculating interaction force. This force is applied to the object surface for deformation while the opposite force is sent to the haptic device. For the cutting tool, the cutting process begins once the interaction force exceeds a certain limit, and an alternative neighboring search algorithm using spatial coherence is used for collision detection instead of AABB tree.

Target objects in surgery simulation are usually human tissues and organs. These objects deform considerably under external force, and are thus referred to as "deformable objects." Simulating deformation of deformable objects is what differentiates surgery simulation from other virtual reality applications involving only rigid bodies. Deformation calculation usually consumes a large amount of computational time, so efficient algorithms and implementations are essential to meet real-time requirements. We implement two deformation algorithms, both based on the Finite Element Method. One algorithm pre-computes deformation modes under unit force vectors and uses super-position to calculate displacements of vertices under external forces. The other algorithm is based on a tensor-mass model. The stiffness matrix is distributed to vertices and edges as tensors while the mass of each tetrahedron is distributed to its vertices. The algorithm dynamically calculates changes of velocities and positions of vertices and is computationally more intensive, but does not need pre-computation.

Cutting is one of the most basic operations in surgery. To make cutting realistic, the cutting wound has to form gradually following the cutting tool movement in the target object. The consistency of the mesh data structure has to be maintained during cutting. We implement two cutting methods. The first one uses a minimal element subdivision method to split tetrahedrons swept by cutting tools into smaller tetrahedrons. This method requires classification of tetrahedron cutting state and can sometimes run into invalid states due to irregular movements of the cutting tool. The second method forgoes cutting state classifications. It is divided into two stages – subdivision and splitting. In the subdivision stage, tetrahedrons swept by the cutting tool are subdivided to eliminate face and edge intersections. No cutting wound is formed in this stage, but after subdivision, the cutting path is composed solely of tetrahedron faces. In the splitting stage, these faces on the cutting path are split into two to form cutting wound.

Our future research will focus on the following aspects:

- Simulating sewing operation. This involves simulating interaction between the needle, suture and target objects, as well as deformation and knot tying of the suture.
- Interaction between two deformable objects. Currently we can only simulate interaction between one surgical tool and one target object. Real surgical operations often involve multiple tissues and organs. Collision detection and response algorithms for two deformable objects are more difficult to design than two rigid bodies since both objects can deform, and deformation affects collision results conversely.
- Non-linear deformation. Our current deformation algorithms use linear-elasticity. But real human tissues are highly non-linear and anisotropic. Non-linear finite element theory is much more complex than linear finite element. Also super-position principle no longer applies in non-linear case. Designing efficient non-linear deformation algorithms is a challenge.
- Using GPGPU. GPU has been used in general-purpose computation for quite some time now. With the recent driver support from both NVidia and AMD, using OpenCL to write platform-independent programs to directly harness the parallel processing power of GPU without going through the rendering pipeline finally becomes a reality. There has been very little research on using GPGPU in surgery simulation. We will explore the possibility of using GPGPU to accelerate deformation and collision detection algorithms of deformable objects.

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Figure 2. Surgery simulation on a liver model.

(a) Liver model **(b)** Opening cutting wound by grasping **(a)** Wireframe


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Annual Review of Cybertherapy and Telemedicine 2009

Advanced Technologies in the Behavioral, Social and Neurosciences

Cybertherapy – the provision of healthcare services using advanced technologies – can help improve the lives of many of us, both patients and health professionals, while tackling the challenges to healthcare systems.

Despite the potential of cybertherapy, its benefits and the technical maturity of the applications, the use of cybertherapy services is still limited, and the market remains highly fragmented. Although many countries – including USA, Europe, Korea and Japan – have expressed their commitment to wider deployment of cybertherapy, most cybertherapy initiatives are no more than one-off, small-scale projects that are not integrated into healthcare systems.

It is recognized that integrating these new types of services in healthcare systems is a challenging task. The aim of this book is to support and encourage all the interested countries in this endeavor, by identifying and helping to address the main barriers hindering the wider use of cybertherapy and by providing evidence to build trust and acceptance.

Healthcare systems focus on meeting the needs of patients. Achieving cybertherapy's potential, therefore, depends on patients being convinced of its ability to satisfy their healthcare needs. Acceptance by patients depends crucially on acceptance by the health professionals treating them, given the high degree of trust the former place in the latter. An important factor for ensuring the confidence and acceptance of health professionals is enhanced dissemination of the evidence base regarding the effectiveness of cybertherapy services, their safety features and user-friendliness.

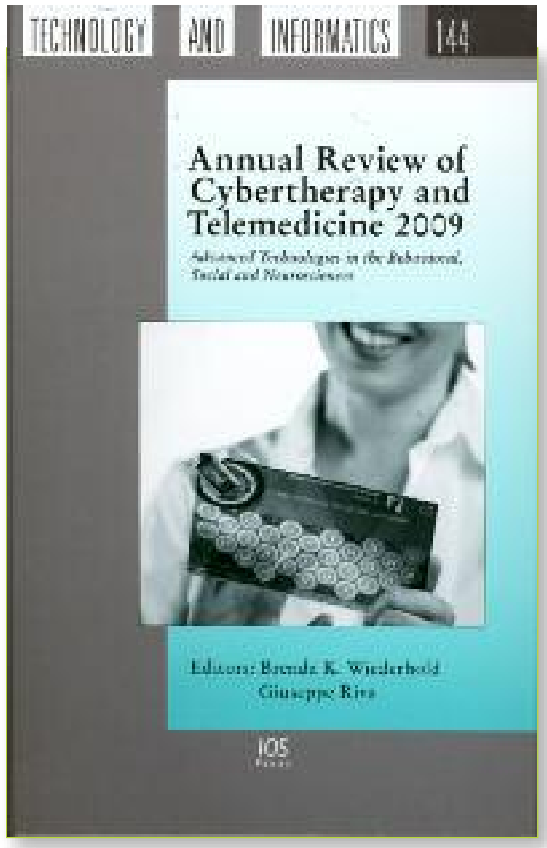
Contents:

• Critical Reviews: They summarize and evaluate emerging cybertherapy topics, including Interreality, CyberAddiction and Telemedicine;

• Evaluation Studies: They are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;

• Original Research: They presents research studies addressing new cybertherapy methods or approaches;

• Clinical Observations: They include case studies or research protocols with a long-term potential



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> **COUNTRY** FOCUS

C&R in South Korea

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Mental illness has long been stigmatized among Asian societies and South Korea proves to be no exception. Because of this reason, it is extremely difficult to treat due to denial and the fear that admitting mental illness will bring shame. The hope is that by doing away with this stigma, more may seek treatment.

Currently experts in the mental health area in South Korea are focused on implementing changes that will result in heightened awareness and a broader scope of treatment options. Stigmatization of mental illness in Asian societies has made treatment difficult, as many individuals are hesitant to seek treatment and instead suffer in silence rather than bring shame to themselves and their families.

The stigma attached to various mental illnesses has resulted in a lack of a well-developed concept of mental illness, a common trait to most Asian nations. The treatment used in the West, of a recovery-based consumer-driven system, has not been implemented in South Korea. Without a solid understanding of different types of mental disease, the results have become apparent in disheartening statistics like a high suicide rate.

Troubling suicide rates

In 2008 South Korea had the highest suicide rate out of the 30 nations that make up the Organization for Economic Cooperation and Development (OECD). Between 1995 and 2005 the suicide rate more than doubled from 11.8 per 100,000 to 26.1 per 100,000. Currently, an average of 38 people commit suicide each day in South Korea, making it the fourth cause of death in the country.

One concern is the "glorification" of suicide committed by prominent celebrities such as popular actress Choi Jin-sil, who killed herself in 2008. Copycat suicides have been recorded throughout the country, such as five reenactments of a protestor, Chun Se, who set himself on fire and plunged 15 feet to his death to symbolically protest the beating deaths of student demonstrators. Surveys have shown that young people in South Korea view suicide as a right.

Everyday stress in a fast-paced society that pressures young people to become successful is trying as well. Suicide rates spike around midterm exams for high school students – a time in their life that may determine whether or not they will get into a prestigious university. Stress in the workplace, as well as competition among peers, has also been steadily rising, according to studies, and has resulted in a higher number of workers suffering from depression and mental illness.

To explain these numbers, the National Statistics Office, for example, blamed the bad economic climate resulting from the 1997 financial crisis. Social dislocations during a period of rabid urbanization in the 1980's have also been given as a cause for increased incidence of mental illness and in 2005, the

Population (Million)	48.8
Urban Population (Million)	10.0
Unemployment Rate	3.3%
Life Expectancy (years)	79.2
Psychiatrists (per 100,000 Inhabitants)	5.1
Number of Universities Offering Psychology Programs	36
Population Median Age (years)	35.4
Population Self-Assessing Health as Good	51%
Suicide Rate (per 100,000)	26.0
Psychiatric Hospital Beds (per 100,000)	75.78
Fertility Rate	1.2
Extrapolated Prevalence to Eating Disorders (total)	0.1%
Extrapolated Prevalence to Schizophrenia (total)	0.1%
Extrapolated Prevalence to Anxiety Disorders (total)	6.4%

OECD cited the causes as changing and conflicting gender roles, domestic violence and economic hardship. Complications of actual causes are then magnified by the inattention paid to mental illness itself.

Rising Awareness

In 1985, when the Ministry of Health and Social Affairs estimated the number of people suffering from various forms of mental illness to be roughly 400,000, it made a decision to attack the problem with a large-scale program opening a number of new mental health care facilities and institutions. Any new hospital opening was now required to set aside a wing dedicated solely to psychiatric treatment.

The World Health Organization estimates suicide victims have a mental illness rate of 90 percent, usually in the form of depression or substance abuse. To address the need to decreases suicides in South Korea, there needs to be a greater dissemination of knowledge concerning mental illness – the fact that it is normal and exists throughout every walk of life, and that it is treatable. Currently, traditional forms of treatment are being supplemented by the application of new technologies such as VR.

CyberTherapy Applications in South Korea

For over a decade the Department of Biomedical Engineering at Hanyang University has been at the forefront for implementing new technologies to treat medical and psychological illnesses. The research done by Professor Sun Kim and his team has made the university one of the leading labs in the country employing VR and other advanced technologies for treatment, training and assessment.

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To further understanding of the human brain mechanism, Professor Kim's lab is focused on employing information and communications technology (ICT) research to psychiatric disorders and rehabilitation, in particular. The main body of research, conducted in a VR lab at Yonsei Medical School, focuses on neuroscience, rehabilitation and psychiatric disorders. An increase in public and private aid is rapidly improving research opportunities.

South Korea has been active in collaborating with countries around the world. This is encouraged by the fact that many specialists receive education overseas or have had experiences abroad. Currently, Professor Kim's lab is involved in a joint project with City College of London. Although clinical studies in neuroscience and other areas may not always be readily compatible with foreign culture, participating in international projects enables researchers in South Korea to more easily adapt their studies to an international environment.

Kim believes that the future of ICT will consist of a more multimodal environment and the use of bidirectional media. He says, "Technology based on a better understanding of the human psyche will play a crucial role." With increasing funding and a focus on intercultural research and international projects, South Korea is working to change the way that mental healthcare is both viewed and treated.

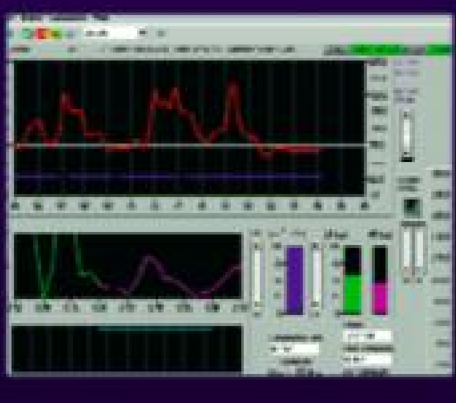
A Bright Future

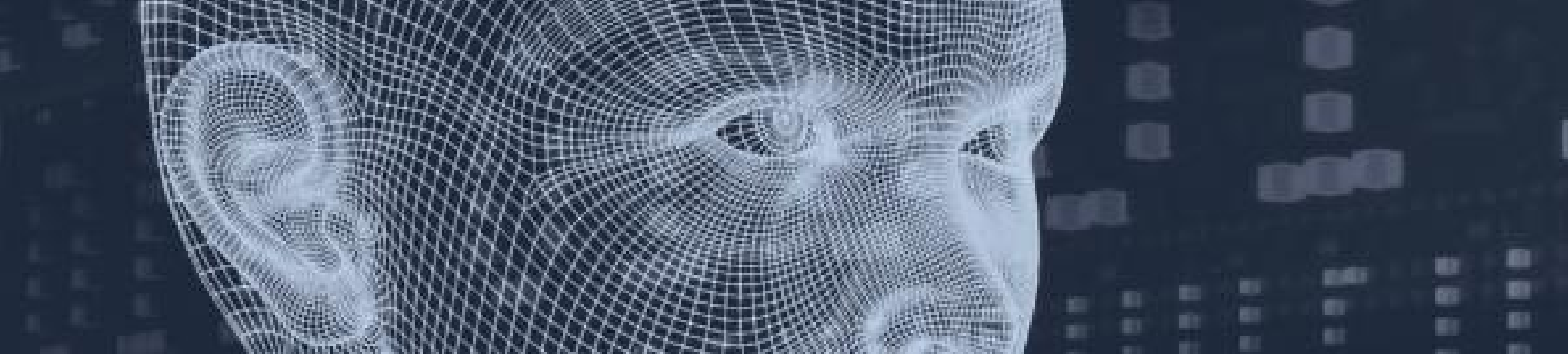
For the first time in 15 years, The Annual CyberTherapy & CyberPsychology conference will be held in Asia. The conference will be hosted in Seoul on June 13-15, 2010. Topics to be discussed include uses of advanced technologies such as virtual reality simulations, videogames, telehealth, video-conferencing, the internet, robotics, brain computer interfaces, wearable computing, non-invasive physiological monitoring devices, in diagnosis, assessment, and prevention of mental and physical disorders. In addition, interactive media in training, education, rehabilitation, and therapeutic interventions will be explored. A second focus will also include how new technologies are influencing behavior and society through cyberadvertising, cyberfashion, and cyberstalking to name a few.

The time has come for change in the treatment of mental and physical illnesses in South Korea. Along with a prestigious conference bringing world-renowned researchers from around the world, experts within its borders are taking steps to bring attention to topics that have long been considered taboo. To confront these problems head on, the first steps are awareness and acceptance of mental health disease. By acknowledging these problems and implementing tools to improve treatment, South Korea is well on the way to improving the overall mental health of its population.

Sources:

Personal communication with Professors Sun Kim and Jang-Han Lee, World Health Organization and countrystudies.us.





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