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Journal of CyberTherapy &Rehabilitation

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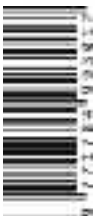A Serious Game for Total Knee Arthroplasty Procedure

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THE VIRTUAL REALITY
MEDICAL INSTITUTE

JOURNAL OF CYBERTHERAPY & REHABILITATION

Volume 3, Issue 3, Fall 2010

THE VIRTUAL REALITY
MEDICAL INSTITUTE

Brussels, Belgium

San Diego, California

International Association of
CyberPsychology, Training & Rehabilitation

JCR
Journal of CyberTherapy & Rehabilitation

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EDITORIAL

We are pleased to bring the Fall 2010 issue of the Journal of CyberTherapy & Rehabilitation (JCR) to our expanding audience around the world. Our quarterly published peer-reviewed academic journal explores the uses of advanced technologies for therapy, training, education, prevention and rehabilitation. JCR continues to actively focus on the rapidly expanding worldwide trend of applying groundbreaking technology towards the field of healthcare.

To educate our readers on new advancements in fields such as robotics, adaptive displays, E-health, virtual reality (VR) and non-invasive physiological monitoring as they are applied to diverse disciplines in healthcare, we present comprehensive articles submitted by preeminent scholars in the field. This issue includes topics such as the creation of a virtual aquatic world to aid in education and using night vision during operations to possibly allow greater VR immersion for patients while in surgery.

In the first article of this issue, Wrzesien presents a pilot evaluation of a virtual interactive learning system aiming to teach children about the Mediterranean Sea and relevant ecological issues. The author also considers ways to improve the software after receiving preliminary feedback.

Next, King, Delfabbro and Griffiths show the reader how cognitive-behavioral therapy might be employed to treat addicts of video games and discuss preliminary treatment techniques for such an addiction.

Thirdly, Rodrigues, Sauzéon, Wallet and N'Kaoua present a study comparing subjects' spatial performance on a pedestrian route based on the type of learning environment, real or virtual, the exploration mode used during the learning phase and the type of spatial test administered at retrieval. Through this study the authors hope to further encourage the development of virtual training and rehabilitation programs.

In the fourth article Cowan et al. discuss a serious game for the purpose of teaching orthopedic surgery residents a total knee arthroplasty procedure using a problem-based learning approach. The study assessed user perceptions of the game's ease of use and potential for learning and engagement.

In the following article, Stadie et al. examine the differences in efficacy of reconstructing a 3-D arrangement of objects presented as a real model, a magnetic resonance image (MRI) or a VR model. The findings were then applied to real life scenarios aiming to optimize the visual basis for anatomy training and surgery planning.

In the sixth article, Mosso et al. present results of surgeries performed on rabbits using night vision goggles and list ways in which this could benefit patients in the future, such as allowing for greater immersion and distraction during operations using VR in a dark room.

Lastly, Tse and Ho address the management of chronic pain in the elderly population, focusing on a non-pharmacological method known as multisensory stimulation therapy.

While continuing to provide our readers with the latest scholarly studies presented in an informative and engaging medium, we will continue to offer the newly added Continuing Education quiz (see page 337 for more details) each issue. In addition, we will now be bringing the readers book reviews, the first of which appears in this issue on page 334, discussing "Interface Fantasy: A Lacanian Cyborg Ontology" by André Nusselder.

Although JCR has been receiving international attention from peers, international institutions and international conferences for some time, we are excited to inform readers that JCR is also continuing to become more widely known and recognized by the scientific community, as evidenced by the fact that it is now indexed with PsycINFO, Elsevier, Cabell's, Gale and EBSCO. This recognition will further our cause to inform the wider

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community about ways in which healthcare can benefit from the applications of advanced technologies.

I would like to take this opportunity to sincerely thank the contributing authors for their inspiring work and dedication to this field of research. I also want to as always thank JCR's Associate Editors – Professors Botella, Bouchard, Gamberini and Riva for their leadership and hard work, as well as or internationally renowned Editorial Board for their contributions. Thank you also to our outside reviewers for taking the time to ensure the rigorous nature of the articles.

As always, we welcome your submissions, comments, and thoughts on innovation.

Lastly, I would like to recognize what a huge success our 15th CyberPsychology & CyberTherapy Conference, held in Seoul, Korea in June, was. As you know, JCR is one of the two official journals of the International As-

sociation of CyberPsychology, Training & Rehabilitation (iACToR). The annual international conference series agreed, in 2009, to become the official conference of iACToR. So, along with CyberPsychology, Behavior, & Social Networking Journal (CPB&SN), CyberTherapy & Rehabilitation (C&R) Magazine, and JCR, we celebrate our Combined Communications Platform. We are very excited for next year's conference to be held June 20-22 in Gatineau, Canada.

We look forward to the future growth of our cause and thank you, our readers and subscribers, for your continued support.

Brenda K. Wiederhold, Ph.D., MBA, BCIA
Editor-in-Chief,
Journal of CyberTherapy & Rehabilitation
Virtual Reality Medical Institute

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LEARNING ECOLOGY ISSUES OF THE MEDITERRANEAN SEA IN A VIRTUAL AQUATIC WORLD - PILOT STUDY

Maja Wrzesien, David Pérez López, and Mariano Alcañiz Raya[1]

The aim of this study is to present a pilot evaluation of the E-Junior application. E-Junior is a Serious Virtual World (SVW) for teaching children natural science and ecology. The application was designed according to pedagogical theories and curricular objectives in order to help children learn about the Mediterranean Sea and its ecological issues while playing. A pilot evaluation on a sample of 24 children showed that students thoroughly enjoyed the virtual learning session, were engaged with, and had fun interacting with the system. Moreover, some suggestions for improvement were given by the participants. The results and their implications are discussed.

Keywords: Interactive Learning Environments, Virtual Reality, Ecology, Serious Games, Children

INTRODUCTION

With climate change and its socio-economical, technical, and environmental impacts, ecological issues have become important topics to teach. Natural science and ecology lessons are often taught to children in the classroom, and the scientific concepts are frequently transferred by a teacher in a conventional way. Although teachers do their best with the available materials, traditional classes of this type do not allow children to interact, observe, or actively explore the environment.

With the development of new innovative technologies, Virtual Reality (VR) systems such as Serious Virtual Worlds (SVW) might be an interesting alternative for some traditional teaching. Certainly, with 3-D graphics and immersive, interactive environments, children can be easily transported from a habitual room space to another world such as the Mediterranean Sea underwater environment. Moreover, the introduction of the gaming aspect in such technologies might bring an additional value. Indeed, in recent years it has been recognized that computer games are enjoyed by millions of people around the world and that they have become an integral part of our social and cultural environment (Oblinger,

2004). Even though there are numerous fields of computer game applications, successful computer games all have one important characteristic in common - the capacity to draw people in (Janett et al., 2008). This effect is hard to achieve for a teacher during the traditional teaching process. Indeed, student motivation continues to be one of the most difficult aspects of teaching (Ames, 1992). Thus, introduction of the gaming aspect in the applications for educational purposes might be an interesting option to consider.

The ability to engage people while playing computer games composed with the educational applications can be found in the systems such as Serious Games (SGs) and SVWs. SGs and SVWs are two of the technologies that have proven to be potentially effective educational tools in numerous application domains (Cai et al., 2003; Holzinger et al., 2006; de Freitas, 2006 ; Lai-Chong Law et al., 2008). More specifically, games used for educational purposes represent a powerful and effective learning environment for a number of reasons (Kebritchi & Hirumi, 2008):

– Games use actions instead of explanations and create personal motivation and satisfaction.

Corresponding Author:

Maja Wrzesien, Instituto Interuniversitario de Investigación en Bioingeniería y Tecnología Orientada al Ser Humano, Universidad Politécnica de Valencia, Camino de Vera s/n, 46022 Valencia, España, E-mail: mwrzesien@labhuman.i3bh.es

[1]Instituto Interuniversitario de Investigación en Bioingeniería y Tecnología Orientada al Ser Humano, Universidad Politécnica de Valencia, Valencia, España

COGNITIVE BEHAVIORAL THERAPY FOR PROBLEMATIC VIDEO GAME PLAYERS: CONCEPTUAL CONSIDERATIONS AND PRACTICE ISSUES

Daniel L. King[1], Paul H. Delfabbro[1], and Mark D. Griffiths[2]

Cognitive-behavioral therapy (CBT) is rationalized to be a highly appropriate treatment modality for problem and addicted users of video games. Drawing on available empirical research in this and allied areas (e.g., problem gambling), this paper presents some preliminary treatment techniques that may be well suited to the known features, correlates, and consequences of video game addiction. These techniques involve monitoring video game use, setting appropriate goals, and overcoming problem cognitions that intensify and maintain video game use. Specialized knowledge of the structural and situational characteristics that develop and maintain problem video game playing is also provided. While problem video game playing appears to resemble pathological gambling in many ways, some distinct phenomenological aspects of video game playing prevent a direct translation of gambling CBT programs to video game players. It is suggested that further research is needed to provide further guidelines and treatment techniques for video game players who suffer problems with their behavior. There is also need for greater funding for more basic and applied research on problem video game players.

Keywords: Video Game Addiction, Problematic Video Game Use, Problem Gambling
Cognitive–behavioral Therapy

INTRODUCTION

Video game playing is an increasingly popular pastime among adolescents and adults around the world. However, a growing body of psychological literature reports that there may be some risks associated with very high levels of involvement in video game technology. In numerous studies, including large population survey studies (Charlton & Danforth, 2007; Fisher, 1994; Gentile, 2009; Griffiths, Davies, & Chappell, 2004a; 2004b; Grüsser, Thalemann & Griffiths, 2007; Rehbein, Kleimann & Mößle, 2010) and smaller-sized qualitative investigations (Chappell, Eatough, Davies & Griffiths, 2006; Griffiths, 2000; 2010a; Wood, 2008), a significant minority of video game players have been identified as problem or dependent users of the technology. These "problem" players reportedly jeopardize work or educational activities, social relationships, and personal well-being in order to play video games for periods up to 80 to 100 hours per week. Some researchers have referred to such high levels of involvement in video games as a form of behavioral addiction, comparable to pathological gambling (Griffiths, 2008a).

Whether excessive video game playing behavior represents a unique disorder or a secondary problem arising from underlying pathologies, such as depression, remains

Corresponding Author:
Daniel King, School of Psychology, Hughes Building, The University of Adelaide, North Terrace, Adelaide SA 5005, Australia, Tel: (08) 830333740, E-mail: Daniel.King@adelaide.edu.au

[1]School of Psychology, The University of Adelaide, North Terrace. Adelaide SA 5005, Australia
[2]International Gaming Research Unit, Psychology Division, Nottingham Trent University

TRANSFER OF SPATIAL-KNOWLEDGE FROM VIRTUAL TO REAL ENVIRONMENT: EFFECT OF ACTIVE/PASSIVE LEARNING DEPENDING ON A TEST-RETEST PROCEDURE AND THE TYPE OF RETRIEVAL TESTS

Jérôme Rodrigues[1], Hélène Sauzéon[1], Gregory Wallet[1], and Bernard N'Kaoua[1]

The aim of this study was to compare subjects' spatial performance on a pedestrian route depending on three factors: (1) the type of learning environment (real vs. virtual); (2) the exploration mode during the learning phase (active vs. passive); and (3) the type of spatial test administered at retrieval (i.e., wayfinding, sketch mapping, and picture ordering). Moreover, each subject was tested two times: 48hr and 7 days after the learning phase.

First of all, regarding the whole data, the results presented in this paper indicate good spatial-knowledge transfer from Virtual Reality to the real world, irrespective to the retrieval tests administered to the subjects. Moreover, the exploration mode does not seem here to significantly influence the spatial performance. In contrast, the subjects' performance was greatly increased on the 7-day compared to the 48hr recall phase, and particularly, on the wayfinding test (i.e., on the most ecological test).

In conclusion, the most influent factor on spatial-knowledge transfer from virtual to real environments seems not to be the active learning of the information, but the testing procedure. The results are discussed using the notions of training effect and transfer-appropriate processing. Although further investigations are needed, the results are already encouraging the development of virtual training or rehabilitation programs addressed to spatial cognitive processes.

Keywords: Spatial Cognition, Virtual Reality, Active/passive Learning, Test-retest Procedure

Spatial cognition refers to the cognitive processes associated with the development of a comprehensive understanding of a 3-D environment, and the utilization of this knowledge for various purposes (e.g., wayfinding). In the domain of spatial cognition, the use of virtual environments (VE) is becoming increasingly important in studies because it opens up many new experimental possibilities. A major issue is then to determine the extent to which spatial- knowledge can transfer from virtual to real environments (RE) (e.g., Péruch, Belingard & Thinus-Blanc, 2000).

In fact, several studies indicate that spatial-knowledge transfer from VE to RE may occur to a large degree (e.g., Foreman, Stirk, Pohl, Mandelkow, Lehung, Herzog & Leplow, 2000; Waller, Hunt & Knapp, 1998) or, at least, partially (e.g., Wilson, Foreman & Tlauka, 1997; Witmer, Bailey & Knerr, 1996). Péruch and Corazzini (2003) suggest that efficient knowledge transfer occurs particularly when the VE replicates relevant characteristics of the real world. However, even when using a good match between the virtual and real environments, many variables seem to influence spatial-knowledge transfer (e.g., Péruch & Wil-

Corresponding Author:
Jérôme Rodrigues, Laboratoire « Cognition et Facteurs Humains » (EA 487), Université Victor Segalen Bordeaux 2, 33076 Bordeaux cedex France, E-mail: rodriguesjerome@free.fr

[1]Laboratoire « Cognition et Facteurs Humains » (EA 487), Université Victor Segalen Bordeaux 2

A SERIOUS GAME FOR TOTAL KNEE ARTHRO-PLASTY PROCEDURE, EDUCATION AND TRAINING

Brent Cowan[1], Hamed Sabri[1], Bill Kapralos[1], Mark Porte[2,3], David Backstein[2,3],
Sayra Cristancho[4], and Adam Dubrowski[5,6]

Traditionally, orthopaedic surgery training has primarily taken place in the operating room. Given the growing trend of decreasing resident work hours in North America and globally, due to political mandate, training time in the operating room has generally been decreased. This has led to less operative exposure, teaching, and feedback of orthopaedic surgery residents. We present a 3-D serious game that was designed using an "iterative test-and-design" method, for the purpose of training orthopaedic surgery residents the series of steps comprising the total knee arthroplasty (replacement) procedure, using a problem-based learning approach. Before implementing the serious game into teaching curricula, the first step, and the purpose of the current instigation, was to conduct a usability study to address user perceptions of the game's ease of use, and the potential for learning and engagement. Real-time, 3-D graphical and sound rendering technologies are employed to provide sensory realism consistent with the real world. This will ensure that the knowledge gained within the serious game can be more easily recalled and applied when the trainee is placed in the real world scenario. Usability test results indicate that the serious game is easy to use, intuitive, and stimulating.

Keywords: Total Knee Arthroplasty, Serious Games,
Virtual Simulations, Learner-centered Teaching, Interactive Learning

INTRODUCTION

Total knee replacement, or total knee arthroplasty (TKA), is a surgical procedure whereby the painful arthritic knee joint surfaces are replaced with metal and polyethelene components that serve to function in the way that bone and cartilage previously had. This provides patients who have experienced painful, deformed, and unstable knees, with reproducible pain relief and improved functionality (Park, Yoon, Kim, Lee, & Han, 2007). Approximately 130,000 knee replacements are performed annually in the United States alone, and the procedure has been rated among the most successful surgical interventions across all surgical specialties, with respect to reliability of results and patient satisfaction

(Lavernia, Sierra, & Hernandez, 2000). In short, TKA involves replacing the articular joint surface of the femur, the tibia, and possibly the patella. Relatively speaking, the tibial and patellar component implantation requires fewer steps and fewer considerations. Correct implantation of the femoral component however is an extremely "position sensitive" surgical procedure and must take into account joint range of motion, limb alignment, degenerative and genetic anatomic abnormalities, and soft tissue releases amongst other factors (Laskin, 1991). The TKA procedure is comprised of a number of steps that are followed sequentially, and each step may involve the use of a variety of specialized surgical tools and equipment.

COMPARING EXPERT AND NOVICE SPATIAL REPRESENTATION ON THE BASIS OF VR SIMULATION, MRI IMAGES, AND PHYSICAL OBJECTS

Axel Thomas Stadie[1], Ines Degenhardt[2], Gerardo Conesa[3], Robert Reisch[4], Ralf Alfons Kockro[5], Gerrit Fischer[1] and Heiko Hecht[2]

Progress in medical imaging and refined methods of surgery planning, such as Virtual Reality (VR), call for an investigation of the acquisition of three-dimensional (3-D) anatomical knowledge as a crucial goal of medical education. This study compared the efficacy to reconstruct a 3-D arrangement of objects that was either presented as a real model, as magnetic resonance images (MRI), or as a VR model.

From April 2005 to June 2006 two groups, experienced neurosurgeons and medical students in their fourth year of medical education, studied a three-dimensional arrangement of water-filled plastic objects either as a real model, using a VR workstation, or by examining the MRI images. They were then asked to reconstruct the model as accurately as possible. The reconstructed models were then compared to the respective original models.

The most accurate reconstructions were achieved when the participants had memorized the real model. VR visualization produced larger errors, and reconstruction accuracy based on MRI scans was worst. Neurosurgeons did not perform better than students.

Our results show that, compared to standard MRI scans, the accuracy of mental representation does benefit from the stereoscopic rendering of the model, which has been built from sequential MRI scans. However, best results were achieved when learning from the original model. Thus, VR is beneficial and at the same time there is room for further improvement when trying to optimize the visual basis for anatomy training and surgery planning, both for expert as well as for novice surgeons.

Keywords: Adult Learning, Interactive Learning Environments, Simulation, Teaching/learning Strategies, Virtual Reality

INTRODUCTION

Spatial understanding (a person's aptitude for understanding 3-D structures and positions of objects) in anatomy is required for many clinical tasks especially in surgery. (Levinson, Weaver, Garside, McGinn, & Norman, 2007) Although this ability has been under research since Shepard's and Metzler's work in 1971, it is still poorly understood in the applied domain. (Shepard & Metzler, 1971).

In neurosurgery, spatial understanding is needed by the surgeon to plan the intervention. A neurosurgical operation is usually planned by the surgeon who obtains a represen-

Corresponding Author:
Axel Thomas Stadie, Neurochirurgische Klinik und Poliklinik, Universitätsmedizin, Langenbeckstrasse 1, D-55101 Mainz, Germany, Tel: +496131172006, Fax: +496131172274, E-mail: stadie@me.com

[1]Neurochirurgische Klinik und Poliklinik, Universitätsmedizin, Langenbeckstrasse 1, D-55101 Mainz, Germany
[2]Abteilung Allgemeine Experimentelle Psychologie, Psychologisches Institut der Johannes Gutenberg-Universität, Staudingerweg 9, D-55099 Mainz, Germany
[3]Hospital del Mar, E-08022 Barcelona, Spain
[4]Zentrum für endoskopische und minimalinvasive Neurochirurgie, Klinik Hirslanden, Witellikerstrasse 40, CH-8032 Zürich, Switzerland
[5]Neurochirurgische Klinik Universitätsspital Zürich, Frauenklinikstrasse 10, NORD 1, CH-8091 Zürich

OPEN SURGERY WHILE WEARING NIGHT VISION GOGGLES

José Luis Mosso Vázquez[1], Melba C. Stetz[2], Roberto González Ojeda[1], Brenda K. Wiederhold[3], Gerardo Arrellin Rosas[1], Elizabeth Rodriguez Schlögl[1], Gregorio Tomás Obrador Vera[1] and Dejanira Mosso Lara[1]

Night vision technology is nothing new. In fact, the military rely significantly on this technology during nighttime operations. A surgeon is like a medical soldier in the battlefield. His/her only mission is that of keeping people alive. Due to many technological advances, patients cannot only train on relaxation while visiting their doctors but also get distracted by playing videogames while waiting for them. Furthermore, this virtual reality experience can be enhanced if the patient wears goggles or Head Mounted Displays under dimmed or absence of lights. The purpose of this study was to test if a surgeon could operate when extending into such a dark condition situation, but in the surgical suite. Therefore, a surgeon performed seven open surgeries on rabbits. All surgeries were performed on the thorax and abdomen regions. Specifically, the surgeon was able to perform these surgeries by wearing on his head a micro camera with infrared light and a night vision goggles. The first assistant used this same system while the scrub nurse and the anesthesiologist did not. There were no complications either during or after these procedures. It is possible to make open surgeries wearing a night vision system. Further approaches should be tested with human volunteers.

Keywords: Night Vision Goggles, Open Surgery, Cyber-medicine

INTRODUCTION

The typical medical tools used to help make diagnoses are white and black color images in double dimension (2-D; e.g., X-rays images, scanner, and magnetic resonance images). Pictures with motions such as ultrasound, cholangiography, cardiac catheterization, and amniocentesis are other examples of how black and white colors permit physicians to help patients with high precision to make invasive medical treatments. Fortunately, during the last decade, technology has helped improve these traditional images with better visualization with three-dimensional (3-D) reconstruction from 2-D medical images. That is, physicians may now interact with 3-D models and feedback devices that help them learn more about the physical and the biological reactions of virtual tissues and organs. In fact, this technological advancement has been crucial in helping prevent medical risks with real organs. Medical simulations help navigate inside reconstructed virtual anatomy to give patients a better diagnosis and plan medical procedures more accurately in the future.

NIGHT VISION TECHNOLOGY AND TREATMENT

Night vision goggles (NVG) are widely used by soldiers to conduct night tactical operations. Some soldiers wearing NVGs have trained with mannequins during intravenous line insertions (Brummer, 2006; MacIntyre, 2007) or even volunteer patients during endotracheal (Schwartz, 2001). Similarly, Mosso and others (Gorini, 2009; Stetz, 2010), have been testing a few applications of these technologies on humans (e.g., psychotherapy and recovery surgeries) to test the efficacy of virtual immersion to reduce anxiety and pain in the surgical suite. Surgeons are like soldiers trying to work only with white light colors. Therefore, surgeons wearing NVGs may avoid unnecessary dissections that may cause high surgical risk of fatal bleeding (see concept in Figure 1). The purpose of this paper is to share pre-

Corresponding Author:
José Luis Mosso Vázquez, School of Medicine, Universidad Panamericana, Mexico, E-mail: jmosso@up.edu.mx

[1]School of Medicine, Universidad Panamericana, Mexico
[2]Tripler Army Medical Center, Hawaii, U.S.A.
[3]Virtual Reality Medical Institute, Brussels, Belgium

MANAGEMENT OF CHRONIC PAIN FOR OLDER PERSONS: A MULTISENSORY STIMULATION APPROACH

Mimi M.Y. Tse[1] and Suki S.K. Ho[1]

Since the prevalence of chronic pain among the elderly is high and reduces their quality of life, effective non-pharmacological pain management should be promoted. The purpose of this quasi-experimental pretest and posttest control design was to enhance pain management via an 8-week multisensory stimulation art and craft appreciation program (MSSAC). Residents from two nursing homes were randomized into an experimental group with MSSAC and a control group with regular care but without MSSAC. Relevant data were collected from both groups before and after the MSSAC. The MSSAC consisted of an 8-week program, with one session per week consisting of an art and craft activity and practicing multisensory stimulation therapy.

There were 59 and 82 older people in the experimental and control group respectively. No significant differences were found in their demographic characteristics, pain parameters, number of non-pharmacological strategies for pain relief, effectiveness scores on the non-pharmacological therapies, and psychological wellbeing at the baseline. Upon completion of the MSSAC, there was a significant decrease in pain scores and in the use of non-drug methods to control pain. Also, a significant improvement was observed in all psychological parameters in the experimental group, but not for the control group. The MSSAC proved to be effective in reducing pain, enhancing psychological wellbeing, and increasing the use of non-pharmacological therapies for the elderly.

Keywords: Pain Management, Multisensory Stimulation, Non-drug Strategies, Psychological Wellbeing, Nursing Home Residents

INTRODUCTION

With the increase in average life expectancy, the impact of disease, and the greater prevalence of disabilities, older adults are in increasing need of some form of alternative accommodation and/or residential care facilities (Sandberg et al. 2001). It has been estimated that there is more than a 40% chance that individuals aged 65 and older will spend time in a nursing home (Sandberg et al., 2001).

Most age-related diseases and illnesses bring chronic pain and disability. Pain is common in our aging population, and particularly so among older adults living in nursing homes (Bishop et al., 2007). Fifty percent of community-dwelling adults aged 60 or over have been found to experience pain, and this number increases to 45-80% in the nursing home population (Ferrell et al., 1990; American Geriatric Society, Panel on Chronic Pain in Older Persons, 1998; Chung & Wong, 2007). Although pain is common among nursing home residents (Fox et al., 1999), older people living in nursing homes are at risk of not having their pain assessed and not receiving adequate treatment even if pain is documented (Achterberg et al., 2009). One of the greatest challenges facing nursing today is the provision of proper pain management for patients suffering from both acute and chronic pain (Sicilliano & Burrage, 2005). However, lack of knowledge about pain and its treatment remains an important barrier to effective pain management (Jones et al., 2004).

Corresponding Author:
Mimi M.Y. Tse, School of Nursing, The Hong Kong Polytechnic University, Kowloon, Hong Kong, Tel: 852 2766 6541, Fax: 852 2364 9663, E-mail: hsmtse@inet.polyu.edu.hk

[1]School of Nursing, The Hong Kong Polytechnic University, Kowloon, Hong Kong