

Media Technology and its Impact on Human Physiology

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We propose “media technology and its impact on human physiology” as a grand challenge topic for Hong Kong research. The sounds that we hear combined with the images that we see and the consequences of our actions affect how we perceive our world and how we act. Recent advances in information and media technologies have dramatically altered the ways in which we interrelate with the world and with others. Issues such as the media’s impact on mental health, the effect of video games and digital entertainment on child development, the use of media in education, and technology addiction have become increasingly important. Despite or perhaps because of the advancements in information technology, quality of life in technology- and media-rich societies such as Hong Kong has suffered. By researching the effects of media on the body and its implications, we can better inspire new forms of media that increase its potential for positive impact on society while reducing its negative influences. This effort is termed “meaningful media.”

The effectiveness of media and its ability to influence emotion (and hence action) is already well known to advertising companies that regularly use media to influence perception and sway purchasing decisions, although we do not know the underlying mechanisms. Research in the proposed topic will attempt to correlate media experiences with the underlying physiological processes, in particular, that of the autonomic nervous system which relates to stress, anxiety, depression, and related problems. The neurotransmitters dopamine and serotonin seem to relate to desire and satisfaction. Recent advances in neurosciences and real-time biofeedback provide a window into the neurological and physiological processes correlated to emotions and experience. The discovery of mirror neurons (Murkamel 2010) seems to support the hypothesis that the physiological processes arising from physical threats are no different than those arising from perceived (psychological) and media-induced experiences.

Video games and interactive multimedia experiences induce, engage, and influence the mind. Affecting the mind can alter our physiological state, while affecting our physiological state can also alter our thinking and perception. Designing interactive media experiences and measuring real-time biofeedback such as EEG, heart rate and heart rate variability, galvanic skin response, eye-tracking, and facial muscles provides a new methodology to correlate media experiences to physiological processes. Current media experiences can be studied for their physiological impact. It may become possible to develop objective measures for inner experiences such as joy, love, and compassion. Rather than prescribing chemicals for psychological illnesses, perhaps media experiences can induce endogenous chemical production. Interactive experiences including education and training could be personalized to minimize psychological damage. Work in this area can also serve to bridge the humanities and natural science. Researcher expertise related to the proposed topic includes: media technology and design, psychology, cognitive science, neuroscience, human physiology, molecular biology, philosophy, education, and consciousness studies.

Although our proposed topic does not directly address what many people consider to be the most challenging problem facing science today, that of understanding how conscious experience arises or the “Hard Problem of Consciousness” (Chalmers, 2002), the results of this work will provide insight into the relationship between mind and body.

By harnessing the potential of media to influence our minds and bodies, we can use it to benefit society by improving quality of life, advancing education, creating better entertainment or even developing medical applications to more effectively treat physical and psychological disorders. As the media, entertainment, and advertising capital of Asia, Hong Kong industry will benefit from research in this area.

Rationale

The basic thesis for our proposed grand challenge topic is that media experiences engage the autonomic nervous system, triggering the release of endogenous chemicals such as hormones and neurotransmitters (e.g., dopamine, adrenaline) into the bloodstream. The effects of these physiological processes can be measured and serve to form a common basis for emotions and inner experiences that are subjective and traditionally difficult to quantify.

Advancement in medical technology has provided a greater understanding of the human body and its functions. Technologies such as Electroencephalogram (EEG) and the more recently developed Functional Magnetic Resonance Imaging (fMRI) can be used to gauge brain activity when exposed to media. Real-time biometric data collected from

carefully designed interactive media experiences enables researchers to explore the relationship between the mind (engaged by interactive media) and the body (physiological biometric data). Real-time reactions and responses to media stimuli provide a “bridge” between the material world of images, sounds, and physiology, and the mental world of emotions and intentions. Many real-time biometric data such as EEG, heart-rate variability, galvanic skin response, breathing, and eye tracking can be collected, within the cost range of consumer electronics.

Capabilities and Technical Barriers

There are several technical barriers and open research questions that must be addressed towards advancing our knowledge of the relationship between media experiences and the resulting physiological responses. Among these include:

Biometric Sensors – Many technical barriers still exist for capturing real-time biometric information in a cost-effective manner. Large-scale EEG systems include up to 256 sensors and are expensive and cumbersome. Single-sensor EEGs have made it into lower-cost toys, but at the expense of resolution and quality. New algorithms have recently been developed to better filter noise. Mobile devices such as smart-phones provide a ubiquitous platform for continuous capture of heart-rate, EEG, and other biometric data. Consumer applications will require high-performance and low-cost biometric sensors. Is it possible to develop accurate and low-cost, low-maintenance, easy to use biometric sensors for use in consumer applications?

Emotion and Mental State Correlation – Although strong emotional responses influence physiological attributes such as skin response, pupil dilation, heart rate, etc., it is not yet clear how they relate to different emotional states. Diverse biometric factors such as EEG, heart-rate variability, galvanic skin response, pupil dilation, facial EMG, and breathing have different response times that vary in magnitude based upon the mental stimulus. Unconscious sleep disorders may also be identified by irregular EEG patterns. Correlating carefully crafted media experiences with biometric responses will provide a better understanding of how experiences of the mind propagate through the body. In addition to emotions, it may be possible to identify unique EEG signatures for states of consciousness such as boredom, daydreaming, creativity, and “flow” (Czikszenmihalyi, 1997). Are there unique and universal biometric signatures for the different inner (emotional) states of being?

New Cognitive / Psychological Models – Psychological analysis of subjects’ reactions to media influences would also provide insight into not only in what the body does, but how the mind is responding. In order to use media as a device that induces physiological and/or psychological reactions, we must develop more accurate cognitive and psychological models. By studying the way in which the brain reacts to stimuli and how this in turn affects the body, and vice versa, we can gain a proper understanding of the system as a whole. Current instruments such as Myers-Briggs and Enneagrams are based upon questionnaires that are less accurate than real-time responses to direct situations. With the fine-granularity of immersive real-time experiences, what new cognitive and psychological models characterize the behavior of individuals? How can these new models be affected by interactive applications to create personalized experiences that elicit specific responses in real-time?

Personal and Cultural Impact of Media – Media has the ability to change both individual and society, in cognitive processing as well as worldview. Why are stories engaging and compelling? From Aristotle to Joseph Campbell, humans have sought to understand the power of mythology in providing meaning and facilitating life transformation (Bruner and Kalmar, 1998). Grounding the experience of stories in terms of physiological responses provides a scientific basis for studying the efficacy of narrative.

Impact of Media Technology – New studies are making a case that media technologies, including television, video games, and the Internet, are affecting brain development, especially among young children. Studies have shown that Attention Deficit Hyperactivity Disorder (ADHD) symptoms are more prevalent in those who play video games for more than one hour per day (Chan & Rabinowitz, 2006) than in those who do not, which correlates to increased problems in learning and therefore at school. Internet addiction is another area of concern to the mental health field, and has been connected to symptoms such as depression, social withdrawal and dysfunctional behavior (Whang & Lee, 2003). How are information technology products influencing human development?

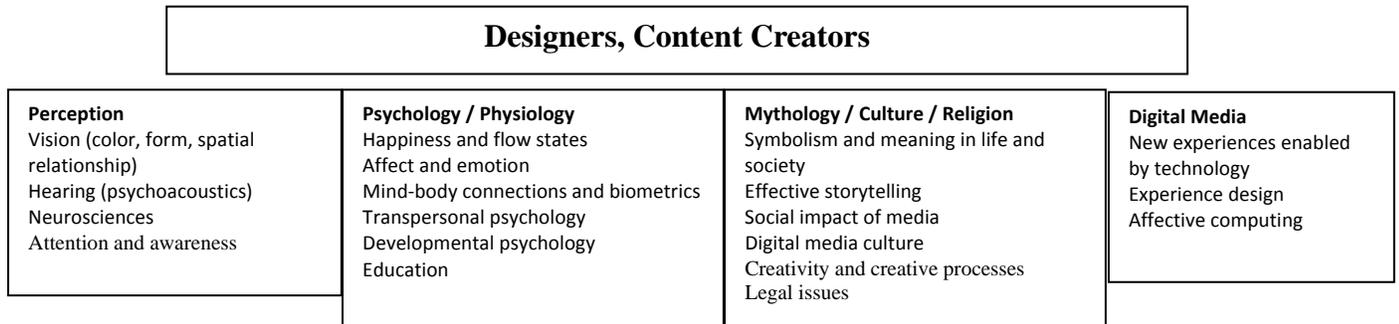
Application Development – With a better understanding of the mind-body relationship, we can gain better insight into the application of media to new domains. Applications include education, emotional intelligence training, wellness promotion, and treatment for psychological disorders such as post-traumatic stress and attention deficit disorder. Experiments have demonstrated the effectiveness of priming on behavior and decision-making (Verplanken and Holland, 2002). Media, especially interactive forms, could be applied to influence behavior in the realization of experiences. What new development methodologies are needed to create these products?

Science of Philosophy – Philosophers are recently interested in the neurosciences to address questions arising from the philosophy of mind, such as the notion of free will (Burns and Bechara, 2007). The legal community has also become increasingly interested in neurosciences to justify deviant behavior (brain disorders affecting behavior changes) and also as

evidence (lie detection). With the rise of brain imaging, neuroethics is an emerging field with many open research issues (Farah, 2005).

Interdisciplinary and Inter-institutional Approach

This development of media technology’s physiological and psychological will draw from a diverse set of disciplines, working together in a highly interdisciplinary manner that spans the sciences and the humanities. The diverse and interdisciplinary nature of the proposed theme has made it challenging to receive proper funding from the existing funding schemes. However, local expertise across this wide range of disciplines exists among the tertiary institutions. Furthermore, the range of facilities from hardware and software development to brain imaging and fMRI also already exists across the different campuses.

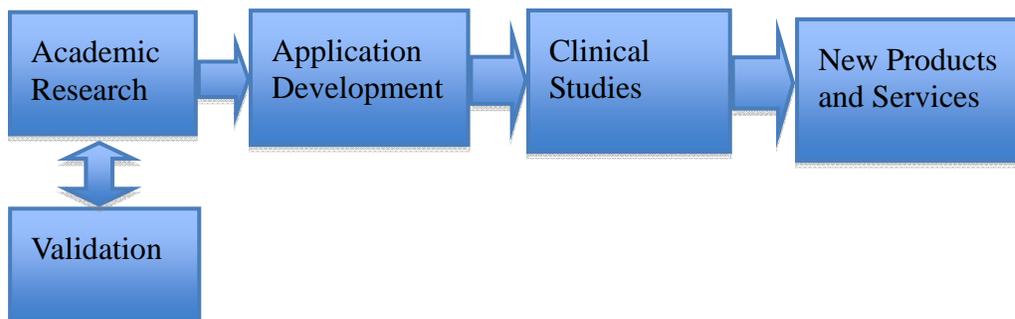


By adopting an interdisciplinary and inter-institutional approach to this research, we will gain a much clearer understanding of media influence, and therefore use it in a beneficial manner to create devices that can contribute to health care, further education, and/or produce better entertainment.

Expected Outcomes

As media and technology become an ever-increasing aspect of daily life, we have a responsibility to create media that is beneficial to both mind and body, while reducing or even eliminating harmful effects. There is already emerging evidence that interactive media can be used to the benefit of mental health. Interactive games, videos, and virtual reality systems are being used to treat Attention Deficit Hyperactivity Disorder (ADHD) and Post Traumatic Stress Disorder (PTSD) (Reger & Gahm, 2008). By playing specifically designed video games that encourage sequencing and learning, subjects' symptoms of ADHD have been minimized. Further analysis of physiological reactions to various forms of media may lead to the elicitation of desired physiological and/or psychological changes, including the treatment of disease.

UGC support in research on “Media Technology and its Impact on Human Physiology” will help to develop an interdisciplinary research community that spans academic institutions in Hong Kong. New research findings can inform the development of products and services offered by Hong Kong’s media, education, and service industries and even China’s as a whole. Research results will also serve to inform the government on policy related to media technology and content.



The diagram above outlines how new findings in academic research can lead to new products and services. Results in the

research labs can be validated through advanced studies such as fMRI or more accurate EEG. Applications that utilize these new findings can be developed through applied programs with funding from agencies such as the Innovation Technology Fund. Clinical studies may be conducted to demonstrate the applications' effectiveness. Through conferences, workshops, and publications, new findings may be made available to the local media and services industries. Demonstration results can attract seed funding and result in new commercial products and services.

From a research perspective, Hong Kong's collective tertiary institutions have the expertise to contribute to media technology and its impact on human physiology. The facilities necessary for conducting detailed brain-imaging investigations such as fMRI and EEG, and real-time capture of biometric data are already available across the different campuses. The resulting work, when applied to create new products and services, will improve mental health and education which is in-line with Hong Kong and the Mainland's policy of improving social harmony and developing innovative methods to improve the traditional education system.

This white paper is written in response to the University Grants Committee's call for White Papers for their Theme-based Research Scheme and may be shared with the public.

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