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Entertainment computing: Inaugural Editorial

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ABSTRACT

Entertainment computing is on its way getting an established research arena in industry and academia as well. To bring all the different contributing research communities together shared resources (e.g. email distribution list, conference series, and journals), organizational structures (e.g. special interests groups, technical committees, etc.) and unifying ideas are helpful. One unifying idea in this diverse community of entertainment researchers and developers might be a normative position to enhance human living through social transformation by entertainment technology.

1. Introduction

The advancement of information and communication technologies (ICTs) has enabled broad use of ICT and facilitated the use of ICT in the private and personal domain. ICT related industries are directing their business targets to home applications. Among these applications, entertainment will differentiate ICT applications in the private and personal market from the office. Comprehensive research and development on ICT applications for entertainment will be of utmost importance for the promotion of ICT use in the home and other places for leisure. So far engineering research and development on entertainment has never been really established on large scale in academic communities. On the other hand entertainment related industries such as video and computer game industries have been growing rapidly in the past, and today the entertainment computing business does outperform the turnover of the movie industry. For example, entertainment robots are drawing attention of young people; the event called Robo-Cup has been increasing the number of participants year by year. Entertainment technologies cover a broad range of products and services: movie, music, television TV (including upcoming interactive TV), video player, voice on demand VOD (including music on demand), computer game, game console, arcade, gambling machine, internet (e.g. chat room, board and card games, multi-user dungeon MUD), intelligent toy, edutainment, simulation, sport, theme parks, virtual reality, and upcoming service robots.

The field of entertainment computing focuses on users' growing use of entertainment technologies at work, in school and at home, and the impact of this technology on their behaviour. Nearly every working and living place has computers, and the great majority of children in industrialized countries have computers in their homes as well. All of us would probably agree that children need to become competent users to be prepared for life and work in the future. Especially children's increasing use of entertainment technologies brings with it both the risk of possible harm [1] and the promise of enriched learning, well-being and positive development [58].

The scope of the research and development arena 'entertainment computing' is obviously quite broad: computer, video, console and internet games; digital new media for entertainment; entertainment robots; entertainment technology, applications, application program interfaces, and entertainment system architectures; human factors of entertainment technology; impact of entertainment technology on users and society; integration of interaction and multimedia capabilities in entertainment systems; interactive television and broadcasting; methodologies, paradigms, tools, and software/hardware architectures for supporting entertainment applications; new genres of entertainment technology; simulation/gaming methodologies used in education, training, and research. A remaining question is how to bring these diverse communities together based on shared and hopefully unifying ideas? In [40,43,42,61,62] we started to sketch the scene.

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2. Entertainment computing and the International Federation for Information Processing (IFIP)

To address and bring up this new area of entertainment technologies it is important to build a good relationship among researchers and between academia and industries. Takahiko Kamae (Japan) initiated setting up a task force group for entertainment computing. The activities of this task force group had as a first and important result that in August 2000 the General Assembly of the International Federation for Information Processing (IFIP) and their Committee for Cooperation with Industries (CCI) approved of setting up a Specialist Group (SG16) on Entertainment Computing.

First of all, the major efforts of SG16 activities were directed toward demonstrating that the subject could be mature enough to attract the broad interest of ICT community. For this purpose a technical event, the first 'International Workshop on Entertainment Computing' (IWEC), was planned and IWEC Steering Committee members were appointed (Bruce Blumberg from MIT Media Lab, USA; Marc Cavazza from University of Teesside, UK; Jaap van den Herik from Universiteit Maastricht, The Netherlands; Tak Kamae from Laboratories of Image Science and Technology, Japan; Donald Marinelli from Carnegie Mellon University, USA; Ryohei Nakatsu from ATR, Japan; Matthias Rauterberg from Eindhoven University of Technology, The Netherlands; Demetri Terzopoulos from University of Toronto, Canada).

A first important opportunity came when IFIP Technical Committee on "Human–Computer Interaction" (TC13) kindly offered a time slot for an international panel on entertainment computing at the prestigious INTERACT 2001 conference held in Japan (Tokyo, July 2001). The IWEC Steering Committee decided to accept this kind offer to increase the presence of SG16 and IWEC. At the panel many conference participants showed interests in entertainment computing.

2.1. Conference series

In the year 2002, the first international workshop on entertainment computing (IWEC) was launched. IWEC 2002 was successfully held at Makuhari (Japan) on May 14–17, 2002. This workshop attracted over 100 participants and over 60 papers were published in the proceedings by Kluwer [41]. At IWEC 2002 were many high quality papers and several interesting technical demonstrations. In other words, evidences that entertainment computing is already an important technical area. At IWEC 2002, we had an extended SG16 meeting, and it was agreed unanimously that the formation of a new technical committee (TC) on Entertainment Computing should be proposed formally to IFIP at the General Assembly at Montreal in 2002.

Based on the success of IWEC 2002, SG16 organised the next event by upscale from workshop to conference: the 'International Conference on Entertainment Computing' (ICEC 2003), that was held on May 8–10, 2003 at the Entertainment Technology Centre at Carnegie Mellon University, Pittsburgh (USA). ICEC 2003 was also successful with more than 100 attendees, 20 highly selected papers, several prestigious keynote talks and invited panels. All the papers for ICEC 2003 have been accepted by ACM for inclusion in their ACM online digital library [34]. To complete the first around the world cycle "Japan–USA–Europe", the third International Conference on Entertainment Computing (ICEC 2004) was held in Europe at the Eindhoven University of Technology in September 1–3, 2004 [63]. This conference attracted 114 submissions of which 62 full papers. Around 150 attendees from academia and industry participated in this successful conference. Full papers, short papers, posters, system demonstrations, and exhibitions from industry were presented in several parallel sessions. The program included three well received keynote talks, three specially invited topic talks, and an outstanding super-chess contest organized by Jaap van den Herik (The Netherlands). ICEC 2005 was successfully organized at the Kwansei Gakuin University in Sanda (Japan) [28], ICEC 2006 at Microsoft Research and University of Cambridge in Cambridge (UK) [16], ICEC 2007 at Shanghai Jiao Tong University in Shanghai (China) [32], ICEC 2008 again at Carnegie Mellon University, Pittsburgh (USA) [69], and most recently ICEC 2009 at Conservatoire National des Arts et Métiers in Paris (France) [48].

Over the last years several conferences on similar topics are initiated by affiliated communities: ACM Singapore Chapter started the conference series "Advances in Computer Entertainment technology" (ACE), and the conference series on Digital Interactive Media in Entertainment and Arts (DIMEA); the Center for REsearch And Telecommunication Experimentation for NETworked communities started the international conference series on "Intelligent Technologies for Interactive Entertainment" (INTETAIN); other related conference series are Conference on E-learning and Games (EDUTAINMENT), European Interactive TV Conference (EuroITV), Conference on designing user experiences for TV, iTV and Internet TV (UXTV), and Fun and Games (FNG). Every year new events are coming up of which some getting established.

2.2. Email distribution list

Having established successfully the conference series ICEC, we started an email distribution list to keep the community informed. The list has grown to about 2500 list members, tendency still growing [20]. The worldwide distribution of list members is about 20% America, 25% Asia, 35% Europe, and 20% industry and other organizations from all over the world. The community is actively using this list to post the latest news and announcements in the field of entertainment computing. In 2009, on average 15 postings are done per month [19]. This initiative is next to the IFIP ICEC Conference series another successful service to build up this new community. To support this aim in addition, a new technical committee started in the International Federation for Information Processing (IFIP).

2.3. Technical committee and working groups

In 2002, IFIP approved establishing a specialist group on entertainment computing (SG16). Showing success and sufficient potential for growth, IFIP approved in August 2006 the upgrade from specialist group to a full-fledge technical committee [18,21].[1] It was a major achievement to get the official recognition and support of IFIP for this upcoming area of Entertainment Computing. TC14 has by now 24 national representatives of IFIP member countries around the globe, and is organized in seven different working groups active which are shortly described below.

Digital storytelling: Storytelling is one of the core technologies of entertainment [7]. Especially with the advancement of ICT, new type of entertainment called video games has been developed where interactive story development is the key that makes those games really entertaining. At the same time, it has not been studied well what is the difference between the interactive storytelling and the conventional storytelling. Also as the development of interactive storytelling need a lot of time and human power, it is crucial to develop technologies for automatic or semiautomatic story development. The objective of this working group is to study and discuss these issues.

Entertainment robot: Robot is becoming one of the most appealing entertainment technologies [14,64]. New entertainment robot

[1] About 20 years ago in 1989 the last approval for a technical committee in IFIP has happened for the area "Human–Computer Interaction" (HCI).

and/or pet robot are becoming popular [15]. Also, from a theoretical point of view, compared with computer graphics based characters and animations, robots are an interesting research object as they have a physical entity [3,22,50]. Taking these into considerations, at the SG16 annual meeting in 2004 it was decided that a new working group on entertainment robot has to be established.

Theoretical basis of entertainment: Although there are huge entertainment industries already such as video games, toys, robots, etc., little academic interest has been paid on such questions as what is the core of entertainment, what is the technologies that would create new entertainment [65], and how the core technologies of entertainment can be applied to other areas such as education, learning and so on. The main objective of this working group is to study these issues [43,44,46,60].

Games and entertainment computing: This working group focus on the research and development of computing techniques for the improvement of computer games and other forms of computer entertainment [9,78]. The scope of this working group includes, but is not limited to the following applications, technologies and activities. Applications are: Analytical games (e.g. chess, Go, poker [54]); Consumer games (e.g. action games, role-playing games, strategy games; mobile games (e.g. mobile phones, PDA's) [52]; interactive multimedia (e.g. virtual reality, simulations); and technologies: Search techniques, machine learning, reasoning, agent technology [2], and Human–Computer Interaction [59,79].

Social and ethical issues in entertainment computing: The aims of this working group are to foster the ethical design, development, implementation, applications and use of entertainment computing [66,67]; to encourage surveys and studies on social, ethical and cultural aspects of entertainment computing [1,36,57,58], to develop methodologies for studying social, ethical and cultural implications of entertainment technology [85]; and to establish a global platform for interaction, exchange, joint initiatives and co-operation between such groups as: The end users of entertainment computing, industrial developers and designers of entertainment computing, policy, decision making, social and consultative bodies, academics and scientists. This working group explicitly cares about the position of and the potentials for, vulnerable groups such as children, the less-educated, disabled, elderly and non-employed people, cultural minorities, unaware users and others [55].

Interactive television (ITV): The aims of this working group are promoting visibility and increasing the impact of research and development in the ITV field [8,24]; to bring together interdisciplinary approaches to ITV research and development issues (e.g. content production, computer science, media studies); to encourage cooperation between researchers and other established bodies and organizations, through the development of joint project proposals; and to facilitate the development of suitable academic and practical teaching programs. Research fields cover alternative content distribution (mobile TV, peer-to-peer TV, IPTV); interactive storytelling, user contributed content; interactive and personalized advertising systems; applications for t-commerce, t-learning, t-health, entertainment; ethical, regulatory and policy issues; interoperability of middleware, standards, multimedia metadata; authoring, production and virtual reality systems; content management, digital rights management; multimedia, graphics, broadcast and video technology; content enriched communication services, video conferencing; personalization, user modeling, intelligent user interfaces; and usability, accessibility, universal access, multimodal interaction.

Art and entertainment: The influence of technology and scientific innovation is profoundly changing how we express ourselves [73]. Arts and Entertainment is a new field that represents the exciting convergence of technology with the established design discipline [72,75]. The Media Arts and Cinema offers a comprehensive approach to design that encourages innovation by media artists, scientists and engineers [45]. This working group will pursue the following activities: To explore the way art and cinema aesthetics can play a role in different areas of computer science; one of its goals is to modify computer science by the application of the wide range of definitions and categories normally associated by making art and cinema [5]; to go beyond the usual definition of art and cinema aesthetics in computing, which most often refers to the formal, abstract qualities of such structures in the context of computer science: a beautiful proof, or an elegant diagram; to research the broader spectrum of aesthetics [84], from abstract qualities of symmetry and form to ideas of creative expression and pleasure [74]; and to prove the assumption behind art and cinema aesthetic computing that the field of computing will be enriched if it embraces all of aesthetics [76].

2.4. A peer reviewed scientific journal

One of the most important initiatives for supporting entertainment computing was launching this scientific journal on 'Entertainment Computing' with Elsevier. This journal has us (Ryohei Nakatsu and Matthias Rauterberg) as founding editors in chief. In addition we have an editorial board of 28 distinguished colleagues from all over the world acting as associate editors, and in addition a growing list of high level experts for the most important task of thorough and rigorous peer reviewing. For the editorial board we have balanced regions (America, Asia, and Europe), as well as academia and industry. Fortunately we could also get the support from IFIP to run this journal as an 'official journal of IFIP'. With the keen interests and kind support from the community we will do our utmost to establish this journal as the premium publication and communication channel for our field of entertainment computing. This might help to achieve a high quality of life by social transformations through entertainment technology.

3. How can social transformation be achieved?

One important kind of social transformation relates to decisions about the use of ICTs in the design, production, consumption, and ownership of news, information, and entertainment media [12]. Van Loon [31] relates an analysis of risk arising from electronic media to that of a transformation in the societal organization of aesthetic experience. His central assumption is "that particular risks cannot be understood independently from the media by which they have been generated" (p. 166). The sets of connections electronic communications have made possible, have amplified not only our capacity to transcend many of the physical limitations of spatio-temporal relations, but also fundamentally transformed the sense of being human. Van Loon argues that in the age of cybernetic reproduction it is no longer helpful or adequate to discuss risks in term of reality versus representation. The notion of 'virtual risks' could be used to discuss the relationships between science, politics, economics, law, the media and popular culture as part of one and the same complexity of connections. Van Loon argues that by following mechanical reproduction and extending it into the organic realm itself, informational reproduction implies a fundamentally new moment. The unity beneath the old dualism between humanism and technocracy needs to be exposed as unethical! We currently face the most critical virtual risks: the death of the human. He concludes: let us "cultivating a responsive sensibility to effect a disclosure of the transgressive implications of the mediation of technology (...) on subjective and biographic experiences" (p. 180).

Maton [35] proposes a multidisciplinary and multilevel framework for social transformation, encompassing the following foundational goals: (1) capacity-building, (2) group empowerment, (3) relational community-building, and (4) culture-challenge. He presents and discusses examples to illustrate the synergistic relationship among the four foundational goals, which is the core of

the social transformation process. He concludes with three challenges to guide our efforts to build the new century: "(1) to move social transformation to the centre of our consciousness as a field; (2) to articulate jointly with allied disciplines, organizations, and citizen groups an encompassing, multidisciplinary, and multilevel framework for social transformation; and (3) to do the above with heart, soul, and humility" [35, p. 25].

In passing from history to nature, myth acts economically: it abolishes the complexity of human acts, it gives them the simplicity of essences, it does away with all dialectics, with any going back on what is immediately visible, it organizes a world which is without contradiction because it is without depth, a world which is open and wallowing in the evident, it establishes a blissful clarity: things appear to mean something by themselves. If we think that the heterogeneous, polyvalent world is a separate structure in its own right, law is disruptable; i.e. the carnival can be held on the church steps. But if this is not the case, if the carnival and the church do not exist independently of each other, then the only way we can challenge the church is from within an alternative symbolic universe. We cannot choose the imaginary, the semiotic, the carnival as an alternative to the law. It is set up by the law precisely in its own ludic space, its area of imaginary alternative, but not as a symbolic alternative. So that, politically speaking, it is only the symbolic, a new symbolism, a new law that can challenge the existing dominant law.

According to Mulvey [39] are three different change processes: (1) order and disorder, (2) liminality, and (3) festivals of the oppressed (e.g. carnival). We will focus on (2): rituals guide an individual through the transitional moments of life, marking the disruption and difficulty of change and reintegration back into the ordered life of a community. There are rites of separation that initiate the process and put the person concerned into a state of privilege or crisis outside the norms of everyday existence. These are followed by transitional rites, during which the person is in a liminal relation to the world, in a no-man's-land, that may well be marked literally by a particular relationship to place ('transitional periods that require a certain autonomy'). These rites are followed by those of re- incorporation.

Liminal and trance are altered states of consciousness which individuals can enter through a variety of techniques, including hypnotism, drugs, sound (particularly music, percussive drumming, etc.), sensory deprivation, physical hardships (e.g. flagellation, starvation, exhaustion) and vigorous exercise (particularly dance). People can also use trance, particularly in the context of 'ritual' events, to learn new strategies of thinking or of relating to one another. There are different types of learning: for example 'conscious learning' is a transaction between consciousness, the environment and memory; and 'unconscious learning', which takes place with the addition of 'outer' and 'inner' ways of learning. These arise through the interaction of consciousness with transpersonal mass and collective consciousness (e.g. Jung's "collective unconscious", [25]). The feedback link between consciousness and unconsciousness gives rise to inner experiential learning or tuning-in to the dynamics of meta-systems transcending man and his immediate environment. It may be enhanced by various techniques, mostly developed in connection with Eastern philosophies (e.g. [23,80]). As the arguments concerning the attainment of liminal and trance states indicate, it is often an advantage to utilize the whole body in order to achieve them; consciousness is a function of the body as a whole neuronal and bio-chemical energy system. Consciousness involves both sensory feedback mechanisms and imaginative practices based in fields of signification which are culturally determined. Significant mental effects can be obtained when the entire physical organism is utilised.

There are several phenomena like psycho kinesis, telepathy, out-of-body experiences, unidentified flying objects, near death experience, time travel, etc. that are waiting for some explanations [70]. Despite its apparent materiality, the universe looks like a kind of 4-D projection and is ultimately no more real than a hologram, a 4-D image projected in space and time [70]. Using this holographic model has developed a new description of reality. It encompasses not only reality as we know it, including hitherto unexplained phenomena of physics, but is capable of explaining such occurrences as telepathy, paranormal and out-of-the-body experiences, 'lucid' dreaming and even mystical and religious traditions such as cosmic unity and miraculous healings.

Mitchell [37] believes that all psychic phenomena involve nonlocal resonance between the brain and the quantum vacuum, and consequent access to holographic, nonlocal information. In his view, this hypothesis could explain not only psycho kinesis and extra sensorial perception, but also out-of-body and near-death experiences, visions and apparitions, and evidence usually cited in favor of a reincarnating soul. One has to admit that these theories are seen often as speculative and not yet part of main stream science. Our long term ambition tries to go a step further by including the idea of social transformation [11]. Activities with and around artifacts have a strong mediating effect of the related explicit, but also implicit ontological forms and structures [4,13]. In the scope of his paper we can look at entertainment technology as an important mediating factor to influence social transformations [12]. Now we will introduce a framework for the development of entertainment technology to support our ideas about social transformations.

4. A new framework for entertainment computing

Human activities in the context of entertainment experiences can be categorized into two major classes:

- *Passive experiences*: Reading novels, watching movies; people watch experiences of others, etc.; sometimes called 'lean back' entertainment.
- *Active experiences*: Doing sports, creating art; people are active participants in the dynamic situation (e.g. [47]); sometimes called 'lean forward' entertainment.

Passive and active experiences are the two poles of the 'activity' dimension. Active experience is mainly correlated with 'physical' presence [33] and passive experience mainly with 'mental' presence. Nakatsu et al. [43] combine 'physical' and 'mental' presence into 'integrated' presence.

- *Physical presence*: To hear sound, look at image, utter speech, move body, exercise, etc.
- *Mental presence*: To use language, read a book, listen to music, watch picture or movie, etc.
- *Integrated presence*: Karaoke, theatrical play, musical performance, sculpture, professional sport, etc.

Integrated presence is based on a proper combination of a certain amount of physical activity and mental imaginations [68]. Mind and body come together in a more enjoyable form of experiences and presence than each separately could achieve. Nakatsu et al. [43] proposed a *new classification of entertainment applications* in which the dimension of 'passive versus active experience' is related to the dimension of presence which is separated into 'physical', 'mental' and 'integrated' forms. In this new framework all existing and upcoming entertainment applications can be classified and categorized in a comprehensive new way (see Fig. 1).

Klimmt [29] and Klimmt and Hartmann [30] have linked interactivity to such diverse dimensions of enjoyment as *effectance*, *sus-*

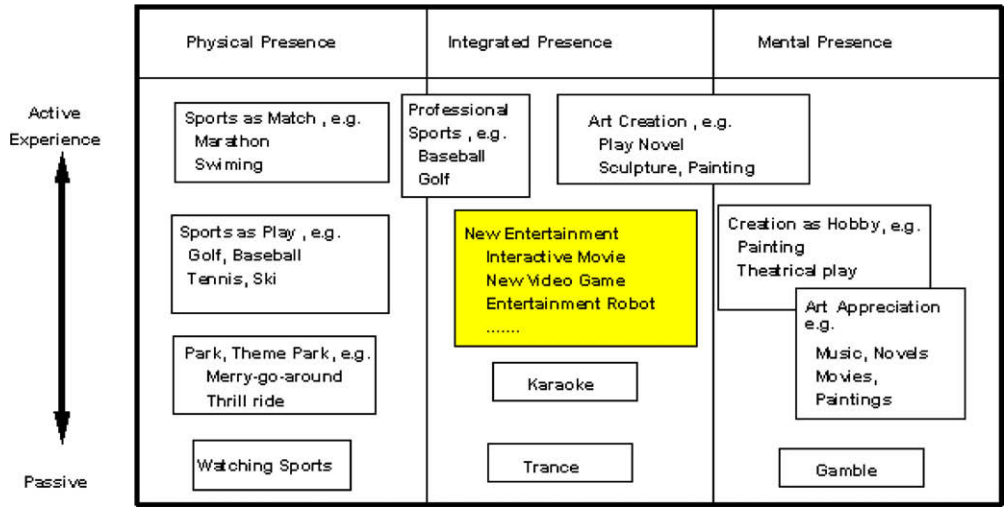

Fig. 1. Classification framework for entertainment applications (adopted from Nakatsu et al. [43]).

pense, *curiosity*, *pride*, and simulated experience of *attractive action roles*. Vorderer et al. [82] have discussed the implications of interactivity for *competitive* forms of entertainment. Based on an intensive literature search [57], Rauterberg could find additionally that *collaborative* forms of entertainment have significant positive effects on human growth and development. Other key characteristics such as sensuous richness [77], audio–visual realism [65], digital narratives [6], aesthetics [51,84], and intercultural differences [49,56,17] have not yet been systematically connected to entertainment theory [38,68,81].

Another important link between presence and new entertainment refers to the assumption that enjoyment only occurs in situations when users perceive themselves as being in *control* [83]. However, very immersive new entertainment applications could induce very captive and overwhelming feelings of presence, which in turn might lead to a reduction of perceived control and thus diminish enjoyment. From this perspective, entertainment experiences can only unfold if users achieve a balance between inner distance to and 'being captivated' by a virtual environment, which preserves a required minimum of perceived control over the situation [27]. The relationship between 'overwhelming' presence, perceived control and entertainment is thus another key objective of future theoretical and empirical investigations.

To include the aspect of embodiment into entertainment technology human–robot interaction is one possibility [71]. At ATR in Japan, Ryohei Nakatsu was involved in the development of the humanoid robot [22]. The ATR researchers have developed a robot called "Robovie" that has unique mechanisms designed for communication with humans. Robovie can generate human-like behaviours by using human-like actuators and vision and audio sensors. The software was a key element in the systems development. Two important ideas in human–robot communication through research from the viewpoint of cognitive science have been obtained: (1) the importance of physical expressions using the body and (2) the effectiveness of the robot's autonomy in the robot's utterance recognition by humans. Based on psychological experiments [26], a new architecture that generates episode chains in interactions with humans was developed. The basic structure of the architecture is a network of situated modules. Each module consists of elemental behaviours to entrain humans and behaviour for communicating with humans.

The concept *embodiment* refers to a theory in which meaning and semantics cannot be captured by abstract, logical systems, but are dependent on a subject's experience derived from being situated in an environment [4]. This theory has recently received a great deal of support in the cognitive science literature [80] and is having significant impact in entertainment computing, artificial intelligence [53] and other disciplines [10]. There is no doubt that embodiment is an important part of human intelligence and future social and cultural developments.

5. Future directions

Over the last decades the rapid innovation in ICT has offered ever faster and more versatile access to ever more data, knowledge and information. Although this is of much practical value, the transformative social power of the technology is based on its opening and closing of opportunities for us to have control over shaping and reshaping our electronic and physical access and the terms of access to the knowledge and other resources we need to enable us to earn a living, learn, engage in political debate and action, meet people, choose our sources of news, information, and entertainment, and many other activities essential to determining our quality of life.

Between now and the near future, digital technologies will become even more powerful and affordable for all users and at every level, in digital networks and in product offerings. An increasing number of people will be able to compile, program, edit, create and share content; as a result, they will gain more control and become more immersed in media experiences. But more than technical challenges, the social implications on human behaviour will be of most importance. We need a media ecology movement to heighten consciousness to fight the waste and pollution that media can produce. It is indeed a challenge for the mental environment of our children and future generations. The questions we must ask ourselves are: Do we give them a world that is challenging, stimulating, inspiring, and really entertaining? Do we encourage their intelligence, creativity and curiosity?

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