Game-Based Interactive Media in Behavioral Medicine: Creating Serious Affective-Cognitive-Environmental-Social Integration Experiences

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Abstract. The need to refocus health systems more towards prevention is now widely recognized, since most of the major disease conditions in the developed world have significant behavioral determinants. However, most efforts to date have been limited in their impact as they have generally failed to take account of the complex hierarchy of interacting social and environmental influences. The reality of life in a networked society is such there is now an additional set of corresponding influences that arise in the digital world(s) that an individual inhabits. Concurrent with these developments, the rapid emergence of a wide range of digital technologies offers a whole new set of affordances and potential health applications. We therefore argue for the design of digital supportive environments that utilize mobile devices, sensors, social media, game worlds and mechanics, in order to create transformative experiences that can effect large scale positive health behavior change.

Keywords: health promotion, games, supportive environment, empowerment.

1 Introduction

The obesity epidemic has grown to such an extent that a former US Surgeon General has deemed it to be a threat to US national security [1]. While the need to shift the focus of health systems upstream and devote more effort and resources towards prevention is now widely recognized, efforts to date have generally had limited success. One of the main reasons for this lack of impact is the complex nature of the interactions of a hierarchy of social and environmental factors that influence every individual's health behaviors [2]. Around the same time that concern was being expressed about military preparedness, the US Army, in recognition of the widespread popularity of video games, developed the highly popular video game "America's Army" to increase awareness of the many potential career opportunities in the military [3]. The enormity of the size of many of health behavior issues that need to be tackled means that any proposed solutions will only be viable if they are scalable to a population level. While some specific individuals/issues may need the intervention of trained health professionals, using digital media is maybe the only realistically scalable and cost-effective way forward. There is therefore a clear need for carefully designed

tools and services that support this endeavor. Many different models of health behavior have been developed over the years [4]. Most tend to focus on the factors that influence the conscious, rational decision making process. Health promotion interventions have then been designed based on these models with the intention of influencing one or more of these in the hope of effecting a positive change in individuals' health behaviors. In a recent study of a weight loss intervention, four leading models were only able to predict a modest proportion of the total variance (20-30%) in the outcome [5]. While this is clearly better than nothing, it starkly illustrates the significant problem with many current approaches.

2   Supportive Environments

As the limited impact of early interventions targeted at individuals' behaviors became apparent, alternative models of health behaviors were proposed that were not solely focused on the individual but including both their immediate and wider social and environmental contexts [6]. This change in perspective has resulted in the recognition of the need to develop "Supportive Environments" that positively support health [7-9]. However, they are generally conceived as being concerned with the creation of physical environmental and social conditions that make the "healthy option" the "easy choice." Sometimes, positive changes can be achieved relatively easily and quickly (e.g. removal of vending machines from schools), other issues will require massive amounts of resources and whole scale changes (e.g. making urban environments conducive to physically active lifestyles). It is therefore, important that such considerations are automatically part of any new development or regeneration projects.

While there is a hierarchy of social and environmental influences surrounding the physical world of a given individual, the reality of life in a networked society is such there is now an additional set of corresponding influences that arise in the digital world(s) that an individual inhabits. In recognition of the many ways in which digital technologies and media have permeated our lives, we have recently proposed an extension to the existing social-ecological model [2] that we have called the *Cyber-Ecological Model* [10]. In addition to the existing concentric spheres of influence in the physical world, our new model adds another parallel set of influences that arise in the digital "world(s)" that people inhabit and that these two sets of influences have at their confluence the individual and their avatar(s). Furthermore, as time progresses, it is anticipated that there will be increasing amounts of interaction between physical and digital influences. However, given the way digital media can transcend physical distance, the impact of more remote digital influences is less likely to be diminished and transnational influences may even have greater significance.

Concurrent with these developments, the rapid emergence of a wide range of digital technologies offers a whole new set of affordances and potential health applications. Mobile location-based media can be used to places digital layers over a current user's surroundings. Such layers have the potential to augment the current environment and provide additional information and/or emphasize aspects positive to health and potentially de-emphasize negative ones. A different approach may be for the layer to present an alternate reality, whereby a game is played out in the real world and involves assigning alternative meanings to real objects such that they become game

artifacts. There is also significant potential to use social media to create a supportive social context. By connecting up users, new forms of peer support can be facilitated, especially if they center on a shared goal, or the supporter constitutes a significant other to the user. It may also be possible to shift social norms by making positive health behavior more visible through social media. Given the imperative to act, it has been pointed out that supportive environments based on digital technology [11] could be designed and built in a much short time and at a fraction of the cost. Thus, it is our view that carefully designed digital supportive environments have significant potential for health promotion and warrant serious consideration.

It is worth for a moment considering the factors that appear important for successful behavior change. In order to try and elicit them, a comprehensive study [12] using semi-structured interviews with almost 400 individuals who had achieved varying degrees of positive health behavior changes was undertaken. The two most commonly cited facilitating factors were "feeling better" and "social support" and indicate that particular attention should be paid to affective and social influences when developing an intervention. In the digital realm, perhaps the best example is the Nike+ system which has attracted over 5 million users [13] and has been referred to as the "World's Biggest Running Club" [14]. While not explicitly designed as a health promotion intervention, the system is intended to attract new users and help them to keep physically active and by doing so benefit the company financially via increased sportswear sales. The system uses sensors to track physical activity and combines this with individual and group challenges, personalized feedback, social interaction, and support, and also game elements including status levels. It is evident from even this brief consideration, that there are many potential new avenues to explore to develop more effective forms of health promotion interventions.

3   Games for Health

There is growing interest in using video games for health applications [15] with much of this interest arising from the fact that they are now a mainstream medium, incorporate high levels of interactivity, and are "*fun*" to play. Neurophysiological research has demonstrated the existence of affective (i.e., emotional) brain circuits devoted to play that appear to be conserved in many mammalian species [16] and it has been postulated that the role of play is in providing "*food for thought*" for the brain. From a sociological perspective, Huizinga [17] in his seminal account of the historical development of human culture and institutions, argues that play has acted as a significant cultural force down through the centuries. In historical terms, digital games are a very recent invention. Compared to traditional games, digital games often have a strong narrative aspect [18]. Storytelling is another ancient cultural phenomenon that has acted as a medium to convey knowledge, insight, and wisdom. In digital games players are often on some form of journey or quest, and many games can and are designed to impact emotionally on players [19]. Thus, from both individual (neurophysiological) and social perspectives, play would appear to have significant potential as a catalyst for change.

4   Affective-Cognitive-Environmental-Social Integration

The *Empowerment Approach* [20] to health promotion has been put forward by Tones and Tilford as a more ideologically sound and practical alternative to existing educational and preventative approaches. This new approach has the ultimate aim of ensuring that individuals and communities actually posses "*genuine potential for making choices*" via three distinct strategies: building social capital, empowering individuals, and creating supportive environments. The *Empowerment Approach* is underpinned by the *Health Action Model* (HAM) [21] which Tones developed in the mid 1980s in response to the issues surrounding increased intravenous drug use. The HAM explicitly incorporates affective influences on health behavior, given that drug use can be "*genuinely and powerfully rewarding*" [21]. The HAM includes both cognitive and affective aspects of an individual's mental processes. There is a three way interaction between these two (intra-individual) processes and the surrounding social norms which give rise to discrete behavioral intentions. What determines whether or not a given intention is translated into a discrete action is determined by the balance of facilitating factors and social and environmental barriers. This process is illustrated across the center of Figure 1. Each discrete action will then generate either positive or negative feedback that then modulates future intentions.

An understanding of the nature and characteristics of each of the specific processes in the HAM provide insight into the way the empowerment approach can be implemented and will be discussed shortly. But, first it is necessary to consider other aspects of Figure 1 in more detail. We have previously discussed the reality of life in a networked society and how our *Cyber-Ecological Model* incorporates the associated digital influences. By overlaying these spheres on the HAM in Figure 1, we are acknowledging that social *Norms* arise outside the individual in both the physical and digital worlds. In the physical domain, the degree of influence of more distal sources is shown to taper, whereas the in the digital domain they are assumed not to diminish. With regard to *Facilitators* and *Barriers*, the many new affordances of different digital technologies would appear to offer a whole new set of facilitating factors, but it also has to be pointed out that there may be new types of barriers that arise in this domain too.

Behavioral Intentions arise out of the interactions between an individual's *Belief* and *Motivation Systems* and social *Norms* that the individual is exposed to. The *Belief System* is the cognitive aspect of the HAM comprises beliefs about the costs, benefits and seriousness in relation to specific health issues. However, their influence on behavioral intention is modulated by the *Motivation System*. The *Belief System* has a more stable and enduring aspect (personality) designated *Self-Concept* and include beliefs the person holds their *susceptibility* to specific disease conditions and about their ability to act (i.e., *self-efficacy* and *perceived locus of control*). In a study investigating why playing video games is enjoyable [22] evidence was found to indicate that game play was meeting the three basic psychological needs (Competence, Autonomy, and Relatedness) posited by Self-Determination Theory [23]. Being able to exhibit competence in performing tasks enables an individual to increase *self-efficacy* and having autonomy to act implies an internal *locus of control*. Finally, relatedness has correspondence with the *sense of community* aspect of the motivation system and is discussed in the next section.
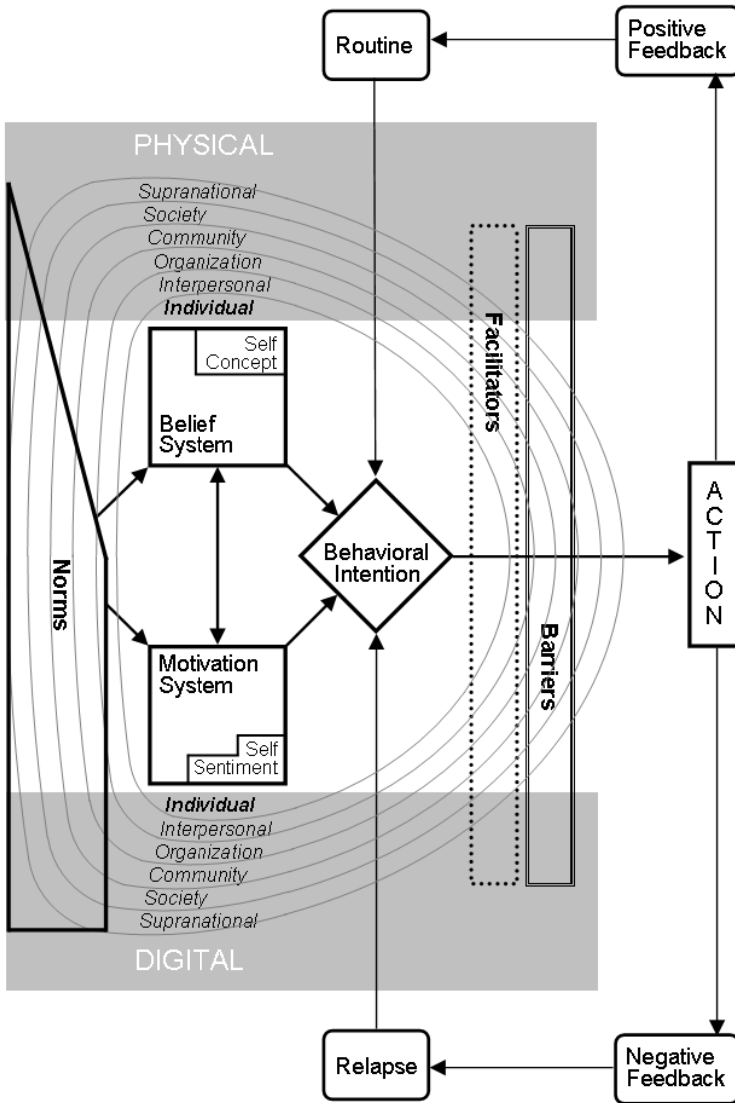
Fig. 1. Combined Cyber-Ecological and Health Action Models

The *Motivation System* involves affective processes and includes an individual's *Values* and *Attitudes*. However, these may be overridden by more basic physiological (e.g. hunger, pain, and sex) or pharmacological (e.g. legal and illegal drugs) drives. Furthermore changing positive or negative affective states (feelings and moods) may have an inhibitory or excitatory influence on behavioral intention. There is also a

personality aspect to the motivation system termed *Self-Sentiment* and incorporates the constructs of *self-esteem*, *sense of community*, *existential control*, and *achievement motivation*. Self-esteem concerns how an individual values themselves and how they are valued by others and how well they can achieve goals valued both by themselves and by the people around them. Existential control involves the attribution of meaning to events, normally to diminish the perceived threat [24]. It is very interesting to note that these constructs have correspondence with a large scale survey of 3,000 MMORPG players [25] which revealed three distinct groupings of play factors that motivated them: Achievement, Community, and Immersion. While the first two are self-evident, the third requires some explanation. Play factors that comprised Immersion included Discovery, Role-Playing, Customization and Escapism, all of which involve the player in the process of attributing meaning to game events/artifacts.

The nature of *Norms* in terms of spheres of influence has already been discussed. At this point it is worth adding that it is how an individual perceives the prevalence of a given norm, their strength of their motivation to conform and the actions and attitudes of significant others. *Facilitating* factors at an individual level these include amongst other things supporting skills concerning social interaction and self-regulation. Beyond the individual these include social and environmental support (*making the healthy option the easy choice*). In contrast, *Barriers* represent external factors which block positive behavioral intentions. Feedback after a discrete action can be either positive or negative. *Positive Feedback* will help to reinforce a particular action such that it becomes a routine (habit). Alternatively, *Negative Feedback* will diminish the possibility of habit formation. At the time that the HAM was developed, Tones [21] highlighted the fact that there were then no positive affective approaches (only negative; e.g., shock tactics) available to behavioral health professionals. While that might have been the case 25 years ago, game-based interactive media have now reached a level of advancement and sophistication that they can be used to create compelling combined cognitive and affective experiences.

5　Creating Serious Integration Experiences for Health Promotion

Having considered the comprehensive nature of the *Empowerment Approach*, we therefore wish to argue for the design and development of digital supportive environments that utilize mobile devices, sensors, social media, game worlds and mechanics, in order to create transformative experiences that can effect large scale positive health behavior change. For example attractive, competent role model characters could promote self-esteem [26] and empathic agents could learn about a player's values and reflect back positive attitudes. In contrast, an in-game buddy, or various forms of group interactions could serve to challenge a player's values and characters exhibiting inconsistent behavior and/or disrupting what is comfortable to believe could promote reflection and discussion. Also, an in-game "*Health Economy*" [27] could be designed

such that a player's drive for gratification is moderated by realistically reflecting their game actions (both negative and positive) in the penalties and rewards applied to their "*Health Score*." Finally, a game could maximize appeal by coming across as lighthearted (to overcome any initial apprehension) and heighten impact by using carefully choreographed changes in the emotions elicited.

Designing and developing such digital supportive environments will be a significant undertaking requiring multi-disciplinary teams. In an attempt to demonstrate the wide-ranging potential of such an endeavor, we have listed each of the above model components along with a potential intervention objective and a corresponding design principle or feature in Table 1 (*Intentions*) and Table 2 (*Actions*). This is only a initial attempt at compiling such a list, but we would anticipate that a compendium of relevant design patterns would be developed in the future.

6   Limitations

The empowerment approach involves three distinct strategies of individual empowerment, the development of social capital and environmental improvement. The combined affordances available from integrating sensors, augmented and alternative realities, social media, and games can be used to design experiences that can act in all three strategic areas. While social/environmental barriers can be diminished by constructive an alternative world lens through which to view them by altering their meaning/value/significance, it has to be acknowledged that this will not negate the need for improvements in the physical environment. Of course, there is also the possibility that such interventions can act as mobilizing forces for community action and political lobbying/demand for change. There is also the possibility that game-based health promotion approaches may be taken less seriously precisely because they are games. However, if carefully designed, it seems likely that they would be a significant improvement on current practice. In order, to fully exploit the design approach we are advocating to health promotion approaches there is a clear need for a systematic program of research given the complexity both of human behavior and the approach advocated.

7   Conclusion

Carefully designed digital supportive environments based on an empowerment approach to health promotion and which utilizes mobile devices, sensors, social media, game worlds and mechanics, in order to create transformative experiences would appear to have significant potential both in terms of reach and cost effectiveness to effect large scale positive health behavior change and warrant a comprehensive program of research and development.

Table 1. Example Design Principles and Features aimed at Behavioral Intentions

Model Component		Potential Intervention Objective	Example Design Principle/ Feature
Belief System	Beliefs	clarify beliefs	present dilemmas where player has to make choices based on cost/benefit trade-offs
	Self-Efficacy	increase belief in ability to perform specific actions	fine-graded challenges
	Perceived Locus of Control	shift towards internal locus of control	ensure player is able to exert a high level of control in the game world
	Susceptibility	clarify beliefs about susceptibility	design a selection of game events to occur with varying but discernable probabilities
Motivation System	Values and Attitudes	clarify values and attitudes	dynamically adjust game values (economy) in response to player actions
	Drives	provide alternative forms of gratification	carefully target game rewards
	Self-Esteem -Self Achievement	facilitate achievement	incorporate multiple levels and permit player to have some choice in difficulty level
	Self-Esteem -Social Achievement	facilitate social recognition of achievement	incorporate status badges, social endorsement functions, empathic non-player characters
	Sense of Community	community building	incorporate social media functionality
	Existential Control	opportunities for customization, discovery and role-play	create a coherent game world and avatars that players can customize
	Achievement Motivation	meaningful challenges, progression	balance challenges to ability level of players
Norms	Perceived Prevalence of social norms	increased encounters with positive role models	include several different non-player characters that can act as positive role models to players

Table 2. Example Design Principles and Features aimed at Behavioral Actions

Model Component		Potential Intervention Objective	Example Design Principle/ Feature
Facilitating Factors	Social Interaction Skills	require collaboration	include team challenges
	Self-Regulation Skills	include time management, checklists, reminders, self-monitoring and journaling functions	support personal skill development and integrate supportive functions with players own tools (e.g. SMS reminders, calendar functions)
	Social Support	mentoring/ buddies/ peer support	incorporate mentoring tasks into game play from more experienced players
	Supportive Environment	location/contextual awareness, provision of relevant information/choices	use location sensing to provide additional contextual information
Barriers	Social	altered meaning/ influence	use game narrative to give altered meaning to barrier and/or internal game economy to increase the benefit of overcoming the barrier
	Environmental	altered meaning/ influence	use game narrative to give altered meaning to barrier and/or internal game economy to increase the benefit of overcoming the barrier
Feedback	Positive	where appropriate increase/ supplement	use game rewards to provide additional positive feedback
	Negative	where appropriate decrease or increase/ supplement	modulate negative feedback, although this will need to be done with great care

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