Creating Fun and Engaging Games: User Experience in a Cognitive Simulator

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Abstract
In this document, we will describe selected game aspects of a cognitive trainer game product. The cognitive trainer, developed by ACE, is targeted on basketball and hockey players. It enables them to improve their cognitive skills using an electronic game.

Author Keywords
Game, cognitive training, hockey, basketball, cognitive simulation.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. See: http://www.acm.org/about/class/1998/ Mandatory section to be included in your final version.

General Terms
See list of the limited ACM 16 terms in the instructions and additional information: http://www.sheridanprinting.com/sigchi/generalterms.htm Optional section to be included in your final version.

Introduction

In contemporary sports, competitive athletes are constantly measured for selected skills: their technical abilities (such as passing and dribbling) and their physical strengths (endurance, speed, strength, agility). Teams invest significantly in improving these skills. However, there is another crucial game skill that has been neglected completely, which differentiates the good from the great. Game intelligence (AKA 'court vision', 'reading plays', or simply 'decision making') has always been considered as a natural gift and therefore a skill that cannot be taught.

The IntelliGym™, a patented technology, is based on a concept originally developed for Israeli Air Force pilots, and funded by DARPA (Defense Advanced Research Projects Agency of the U.S. Department of Defense). Additional studies by the US Air Force and NASA further substantiated the efficacy of this cognitive training methodology. Part of the same team of leading cognitive researchers has now developed IntelliGym™ [1]. Figure 1 presents this early cognitive trainer.

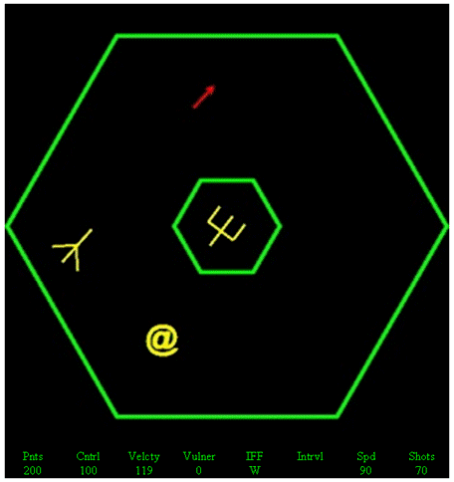

Figure 1. Early cognitive trainer Source: DARPA, Learning Strategies Project [2]

Basketball IntelliGym and Hockey IntelliGym are products targeted on training specific cognitive skills needed by athletes playing basketball and hockey. These are cognitive trainers - a game played on a PC or Mac that simulates the same cognitive skills as those in the real game environment. The game does not necessarily look like the real world, but rather it is designed in such a way that the brain must use the same skills, as in the actual environment. Playing this game simulates the real environment's cognitive processing demands but not its visual appearance. This is why it is called a "cognitive simulator": it simulates the cognitive aspects of the real environment. Figures 2a and b present this idea:

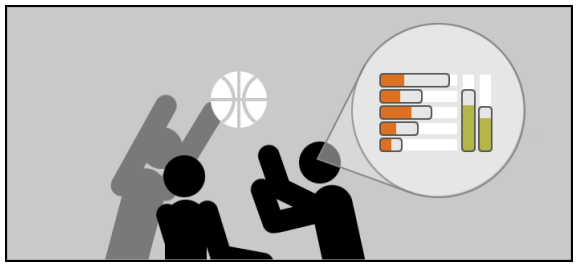

Figure 2a. Mapping the cognitive skill, as used in real environment, such as basketball game.

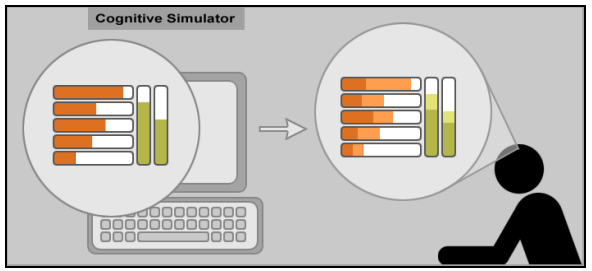

Figure 2b. Training these skills by using a cognitive simulator.

The program addresses a large variety of brain skills that relate directly to players' performance, such as anticipation, ability to find open areas, divided attention, awareness (and particularly spatial perception), long term focus and concentration, team play, working memory (needed to process trajectories that take place in hidden areas, such as behind the player), rapid adaptation to changing environment and the ability to spot evolving opportunities, pattern recognition, execution of game plan, and coping with time constraints. Training on these skills results in much better decisions with substantially fewer errors.

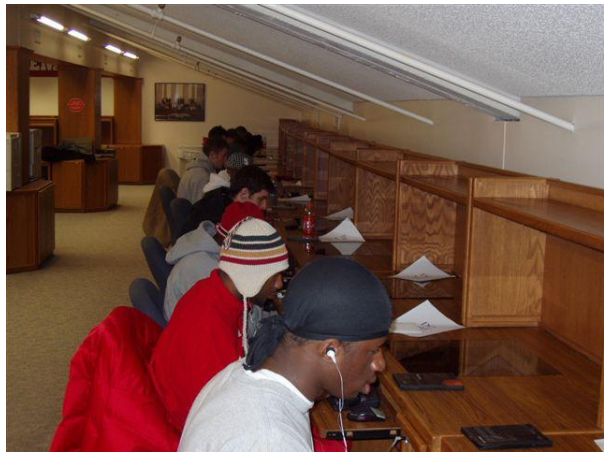

Figure 3. NCAA Division-1 Basketball players during a Basketball IntelliGym™ training session.

ACE's recently developed program, The Hockey IntelliGym™, has been implemented by USA Hockey, and specifically by its National Teams Development Program (NTDP). The results are staggering: since its adoption, three different IntelliGym-trained National teams participated in a total of 12 international tournaments, including three world championships, out of which they won an unprecedented 9 gold medals.

Figure 4. USA National Team, World Championship.

Since a cognitive trainer has many characteristics of a computer game, but is targeted at simulating real world cognitive activity, it faces many challenges, such as how hard can our software pushes its trainees to achieve the maximum improvement before they lose their motivation to play the game, how this adaptive training system can be calibrated to optimize each player, how can it create an enjoyable and engaging game situation, which simulates the world cognitively while creating coherent computer game and so forth.

Controlling user experience – making entertaining simulations

As mentioned above, cognitive trainers are basically sophisticated computer games. Although they look like a "standard" game, perhaps even an old one, they are very hard to design so that they enjoyable and provide excellent cognitive simulation. This is because every element in the game can change the cognitive activity in the game, hence, "damaging" the cognitive simulation. That is, any aspect of the game that is added or subtracted may cause the trainee to use a different skill set, which will no longer resemble the real world. However, if we only consider the accuracy of the simulation, this might result in a boring game design.

For example, Figures 5 and 6 present the Hockey IntlliGym in two modes: "basic" game, and clouds manipulation.

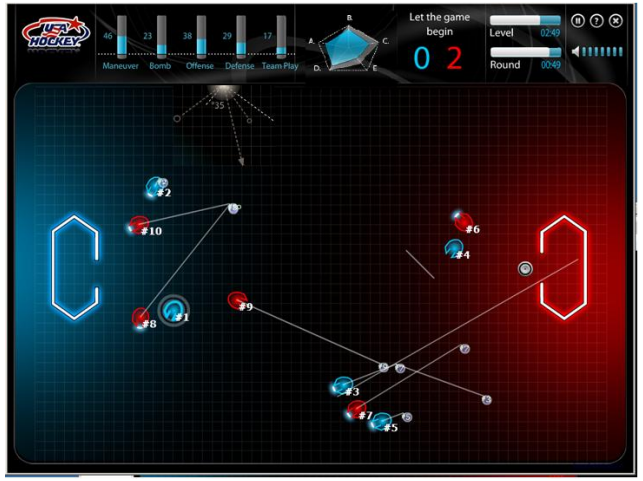

Figure 5. The hockey IntelliGym -- basic.

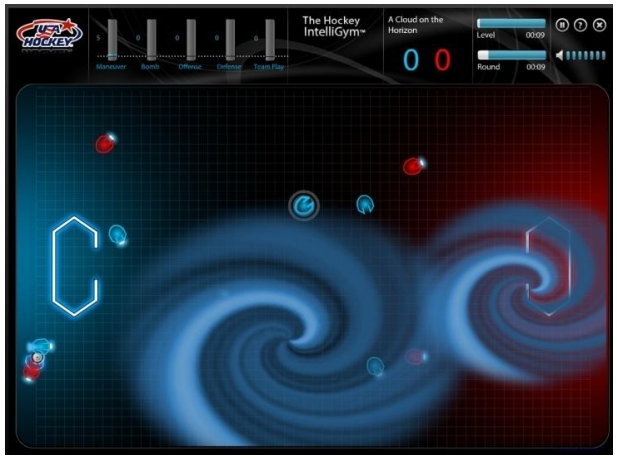

Figure 6. The hockey IntelliGym – clouds.

Figure 5 presents the un-interrupted fun game and Figure 6 the cloud manipulation. With this manipulation, the trainee has to play a game with interruptions such as frustrating clouds moving around the screen. Hence, the trainee has to remember where the opponents and team players are, anticipate where should they go, and act accordingly. This is a difficult task and although very challenging, in many aspects can be judged as a "bad user experience". From the motivational point of view, it is almost impossible to explain to the users that their working memory will improve, enabling them to better process the situation in a real hockey game. There are dozens of such manipulations, each targeted on different combinations of cognitive skills, but making the challenge even greater. In order to deal with this significant challenge, we had to develop a methodology to evaluate each manipulation's effect on the user experience. We have built a methodology for designing the correct "load" for the trainee, as well as analyzing parameters for evaluating the motivational effect on users, based on their activity in the game.

Controlling user experience – making it hard, but not too much so

Another challenge we faced in the world of user experience was the adaptive training program calibration. Since this is a training program and a cognitive simulator, not just a game, we wanted to optimize the trainees' progress. Hence, we built an adaptive training program, which changes the game's difficulty based on the trainee's abilities. We continuously measure the trainees' abilities and control "how hard" it will be for them to play. Since every change in the game has an effect on the cognitive skills and the simulation's reliability, we had to find a way to change the game's difficulty, but with great care. For example, we cold not "help" the trainees in our game by giving them clues, bonuses, new life, force etc'. Alternatively, we researched, and found out that in our game, the main parameter that influences the users' experience is how much control we give them. That is, how competent the trainee feels in the game, and not just the speed of the game. Therefore, although we control game speed as a main adaptation tool for each player, we also control the amount of user control as one of our main difficulty manipulation.

References

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