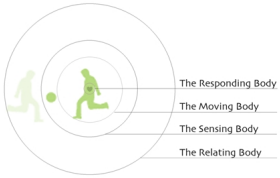
The exertion games we developed have helped us understand the experience for users when engaging with new interactive exertion systems, especially exergames. We used this knowledge to construct theoretical frameworks that can give designers a language to talk about exertion games, inspire new games, and guide the development of new exertion experiences and exergames. For example, Hanging off a Bar came out of one of the classes being taught based on the frameworks.

Here are "things to think about" when designing exertion games:

First, think of the Exerting Body as an Onion with 4 Layers



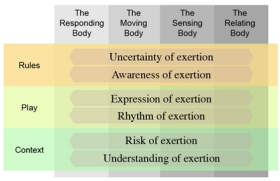
If you think of the exerting body like an onion, there are 4 important layers when it comes to designing interactive technology:

1. The Responding Body: this layer concerns how the body responds to exercise. Most of this response the user can feel, but not control, for example a rise in heart rate or the occurrence of sweat. More and more sensor technology emerges that can use this as input (however, not as output).
2. The Moving Body: this layer concerns how the user's body parts are moving relative to one another. This highlights our proprioceptive sense: we can feel where our hand is in relation to our nose even when our eyes are closed (an old children's game, and sometimes used as drinking game). If we move our body (layer 2), our body responds internally (layer 1), but not necessarily vice versa: for example in Hanging off a Bar, the body hardly moves, however, heart rate raises quickly, so we could have also used heart rate is input mechanism instead of the sensing platform on the floor.
3. The Sensing Body: this layer describes how the body is sensing and experiencing the world, for example most traditional sports involve balls and equipment. This layer also highlights that playing in a big stadium is not the same as playing in the park, even though the pitch might be the same size. For technology design, this might mean that instead of equipping users with sensors, we could put the sensor in the ball.
4. The Relating Body: this layer describes the ways in which bodies and people relate to one another through digital technology. For example, in "races" such as 100m sprints, the athletes do not interfere with one another bodily, they might try to intimidate one another with looks etc., but they are not allowed to use their bodies to prevent one another from winning, which is very different to, for example, in football. This makes designing a networked version of a 100m sprint

much easier than designing a networked version of a football game.

Secondly, see the following 6 elements from the different onion layers

Having now established a couple of views from which to see the exerting body, we can now use these views to discuss 6 important elements of exertion games:



Every game can be explored by rules, play and context: they help us understand the formal structures of a game, the experiences of the people involved, and the larger context in which the game takes place. In exertion games, 2 sub-elements of each are particularly important we found, and these can be seen from each of the onion layers above:

1. Uncertainty of exertion: Uncertainty in a game can arise through the body ("how long can I keep up?") and through the objects involved (think of a ball bouncing of the net in tennis), unlike in most button-press computer games, where uncertainty is pre-programmed by the game designer. This uncertainty is hard to predict for player and technology alike, but can add to the excitement.
2. Awareness of exertion: Digital technology can selectively hide bodily information from players as well as reveal it, for example, in Jogging over a Distance, the technology made players more aware of their partner's breathing, creating empathy, but also distracted them from their own physical pain of running by allowing them to chat with their partner.
3. Expression of exertion: This highlights that we can use our bodies for performances as a way of self-expression, think of the common gestures in sports such as “throwing fists” to oneself or to the opponent, and celebratory dances. Most current computer games ignore this fact, the exception is Guitar Hero, where you get "star-power" if you perform with your guitar like a rock-star (although it would sound the same!).
4. Rhythm of exertion: Unlike most animals, humans can feel a beat. This can be through music, but there is also the "inner beat" when jogging, see the rhythm in flowing movement and heart rate (the right beat over your mp3-player can make you jog faster). Dance Dance Revolution uses rhythm quite excellently: you move to the beat of the music, but also to your partner, making for a spectacle worth watching.
5. Risk of exertion: This highlights the vulnerability of the body to overexertion and injury. However, physical risk is not necessarily bad, it can also contribute to a feeling of thrill. Some say the risk in contact sports is one of the reasons why these games are so successful for team-building.

6. Understanding of exertion: this refers to the potential of a game to support the development of kinaesthetic literacy, or knowledge about the body. For example, a system could provide users with details about their heart rate changes during the game to help them understand their body better, or information about the calories burned. This could be used to create novel experiences, for example the winner is not the player with the most points, but who burnt the most calories.

Having in mind these 6 elements, and seeing them from the different onion layers, helps players talk about their games, and designers to create better games. We have conducted workshops across the world to teach this framework in order to help people profit from the benefits of exertion more.

Publications

The following publication details the framework in much more detail.


Mueller, F., Edge, D., Vetere, F., Gibbs, M. R., Agamanolis, S., Bongers, B., & Sheridan, J. G. (2011). **Designing Sports: A Framework for Exertion Games**. In CHI '11: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Vancouver, Canada.

These earlier publications detail specific aspects of the framework in more detail.


Mueller, F., Agamanolis, S., Vetere, F. & Gibbs, M. R. (2009) **A Framework for Exertion Interactions over a Distance** .
ACM SIGGRAPH 2009. ACM.


Mueller, F., Gibbs, M. & Vetere, F. (2008) **Taxonomy of Exertion Games**. OzCHI '08: Proceedings of the 20th Australasian Conference on Computer-Human Interaction. Cairns,

Australia. ACM, 263-266.