



Gaming the Nervous System



**An Inside Look at Game Design:
Harnessing the Power of Games and
Neuroscience**

What is Media Rez?



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- **Media Rez:** Harnessing proven game design principles from entertainment to health;
- **Projects:** Treatment adherence, relapse prevention, behavior change, resilience, diagnostics.
- **Partners:** NIH, George Washington University, Children's National Medical Center, Mountain Manor Treatment Center, University of Chicago, etc.

What is Media Rez?

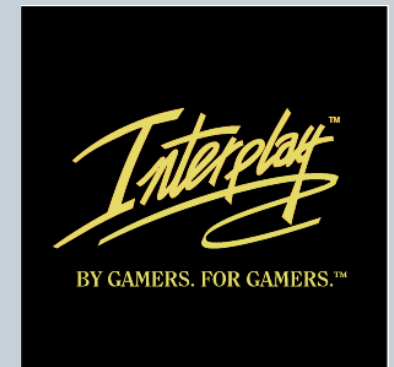


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- **Daniel Greenberg** – 20+ years experience writing, producing, programming, and creative direction for video games. Millions of copies, countless awards.

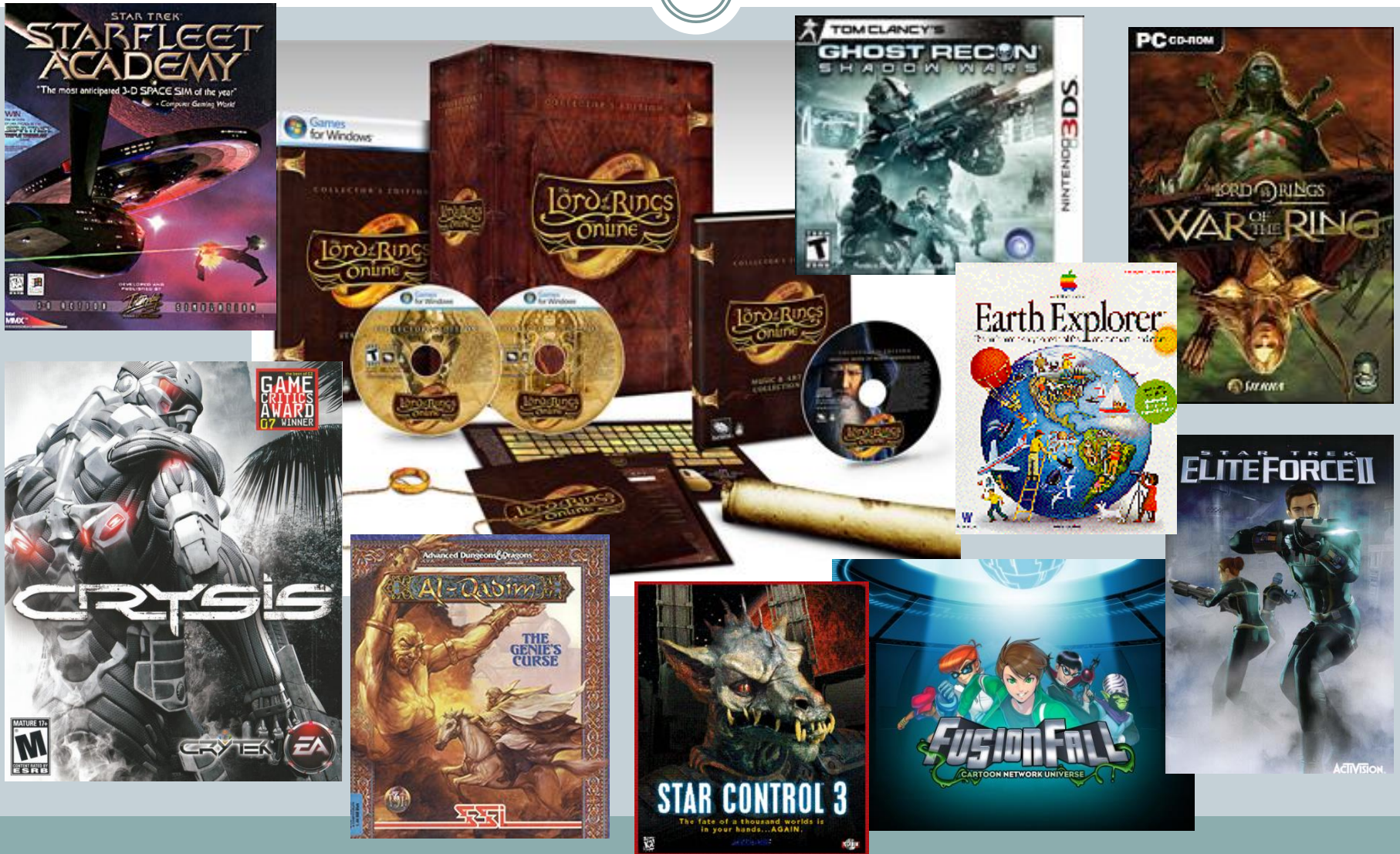
Daniel Greenberg

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Daniel Greenberg

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Effects of Games

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Who thinks that video games cause:

Effects of Games

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Who thinks that video games cause:

- Violence?

Effects of Games

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- Obesity (sedentary lifestyles)

Effects of Games

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Who thinks that video games cause:

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- Obesity (sedentary lifestyles)
- Game “addiction”

Effects of Games

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Who thinks that video games cause:

- Violence?
- Obesity (sedentary lifestyles)
- Game “addiction”
- ...or that games are inherently dangerous, harmful, or bad?

Effects of Games

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Who thinks that the potential benefits of video games outweigh potential harms?

Effects of Games

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Who thinks that the potential benefits of video games outweigh potential harms?

Who thinks the harms of video games are overblown?

Effects of Games

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“...the vast majority of psychological research on the effects of “gaming” has been focused on its **negative** impact...”

“It is likely that this focus will not diminish in the near future, in part because of the enormous media attention...”

“The Benefits of Playing Video Games”

Dr. Isabela Granic

Moral Panics / Scapegoating

14

What are the ethical implications of such an unbalanced approach?

Moral Panics / Scapegoating

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Whenever a compelling and popular new medium appears it is often greeted by accusations of causing societal ills and being “addictive.”

Video games are a compelling and popular new medium.

What else has been accused of causing societal ills and being addictive?

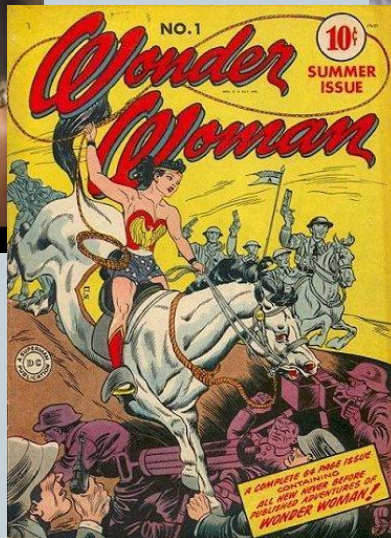
Moral Panics / Scapegoating

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What else has been accused of causing societal ills and being addictive?

Moral Panics / Scapegoating

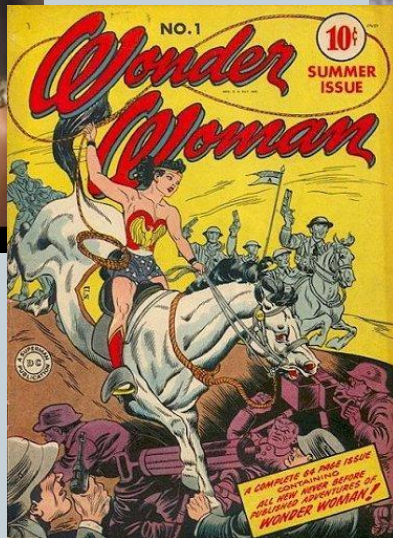
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Moral Panics / Scapegoating

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NOT proved to cause societal ills or be “addicting”:



Game Research

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Poster child for moral panic research: Dr. Wertham



Game Research

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Dr. Wertham's research showed comic books are dangerous and addictive. It decimated the American comic book industry in the 1950s.



Game Research

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BAM! WAP! KA-POW! Library prof bops doc who K.O.'d comic book industry



Photo by
L. Brian Stauffer

Carol Tilley, a professor of library and information science, has found evidence that an anti-comics crusading psychiatrist in the 1950s "played fast and loose with the data."

« Click photo to enlarge

STORY

g+1 +79 Recd f Like 3.

EMAIL SHARE

2/11/2013 | Dusty Rhodes, Arts and Humanities Editor | 217-333-0568; rhodes8@illinois.edu

CHAMPAIGN, Ill. — Behavioral problems among teenagers and preteens can be blamed on the violence, sex and gore portrayed in the media marketed to them – that was the topic of televised public hearings held by the U.S. Senate Subcommittee on Juvenile Delinquency in 1954 to address the scourge of comic books. The hearings, which resulted in the decimation of what was an enormous comic book industry, had been inspired in large part by the book "Seduction of the Innocent," by psychiatrist Fredric Wertham, based on his own case studies.

Wertham's personal archives, however, show that the doctor revised children's ages, distorted their quotes, omitted other causal factors and in general "played fast and loose with the data he gathered on comics," according to an article by [Carol Tilley](#), published in a recent issue of

Game Research

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Try not to get name-checked by the U.S. Supreme Court like one particular video game researcher:

“These studies have been rejected by every court to consider them, and with good reason: They do not prove that violent video games cause minors to act aggressively...”

“[n]early all of the research is based on correlation, not evidence of causation, and most of the studies suffer from significant, admitted flaws in methodology.”

Game Research

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Our culture and media are obsessed with trying to validate moral panics. This leads to unbalanced research, poor results, and wasted opportunities.

Very little research on total effects or positive effects. Mental health benefits (drug-free pain control) go largely unexplored.

The media drools over moral panic research and yawns when research shows otherwise. But what are the ethical implications of concentrating research resources on the presumption that the stuff kids like has to be bad?

Effects of Games

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“Most reported effects of videogames... appear to centre upon the alleged negative consequences.”

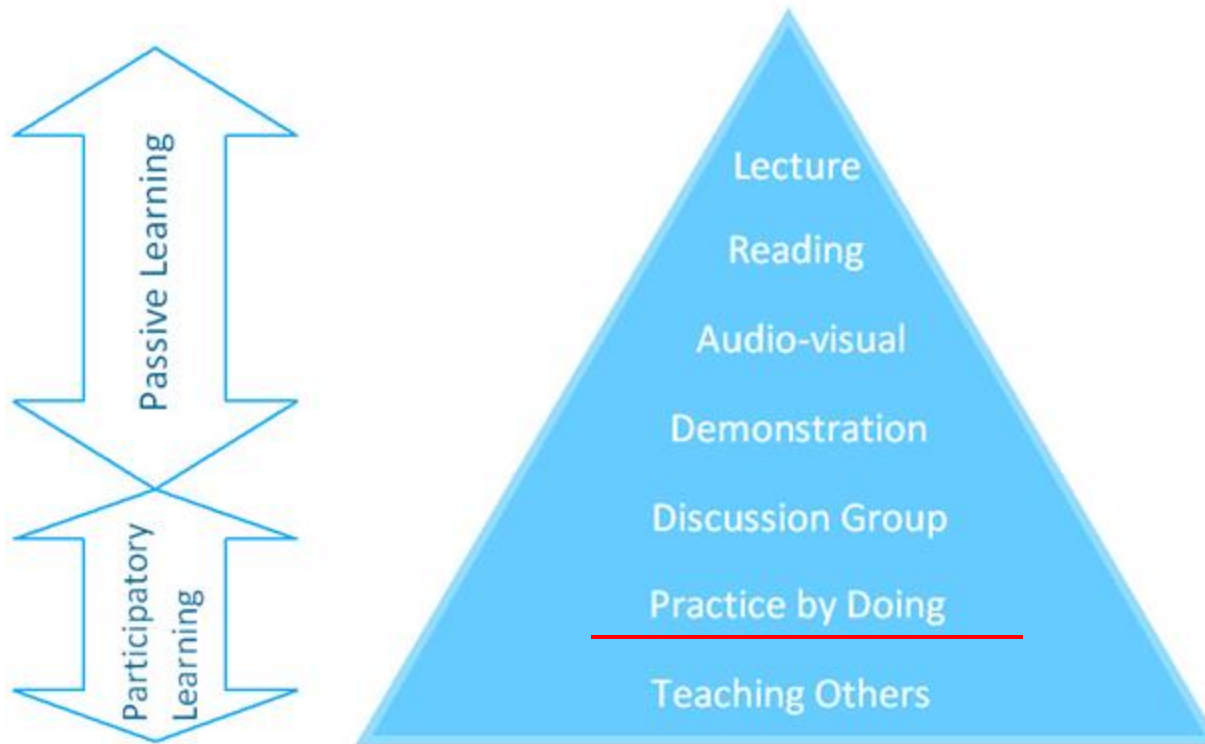
“However, there are many references to the positive benefits of videogames...”

“The Educational Benefits of Videogames”

Dr. Mark Griffiths

Educational Effects of Games

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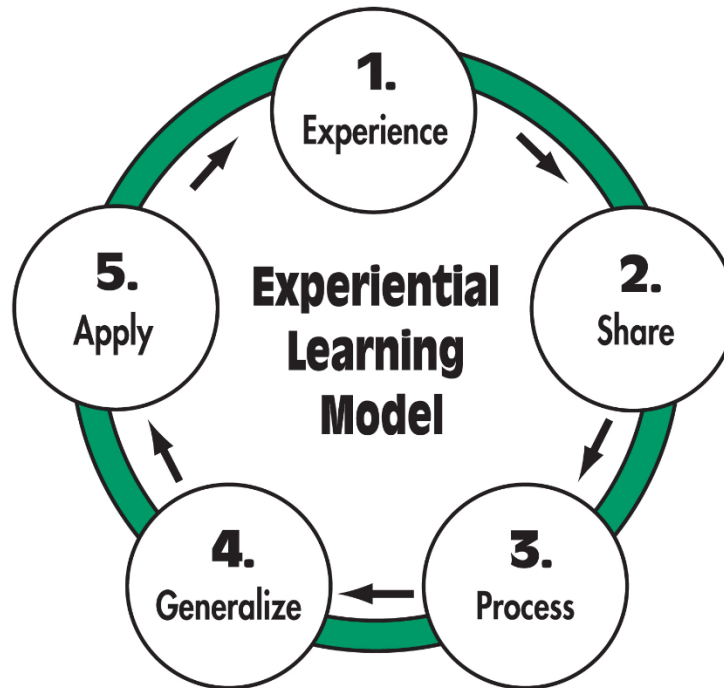


<http://www.games-based-learning.com/2011/07/neuroscience-stress-and-games-based.html>

Educational Effects of Games

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Games map to the experiential learning model:



Pfeiffer, J.W., & Jones, J.E., "Reference Guide to Handbooks and Annuals"
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Effects of Games on the Brain

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- Experiential learning:
- Interactivity: Players rapidly learn material and master complex systems that would fill many books.



Effects of Games on the Brain

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Game Play = Scientific Method

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Game play as the scientific method:

- Players confront an unknown phenomenon
- Act on it
- Observe responses
- Form hypotheses
- Test them in a framework of cause and effect
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- Repeat

Effects of Games on the Brain

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What causes the changes that take place in the brain when we learn?

Effects of Games on the Brain

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What causes the changes that take place in the brain when we learn?

- Practice
- Emotion

James E. Zull http://www.ascd.org/ASCD/pdf/journals/ed_lead/el200409_zull.pdf

Effects of Games on the Brain

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Practice (use or disuse):

Biochemical pathways: neurons grow and reach out to other neurons when they are active.

When we practice something, the neurons that control and drive that action fire repeatedly, growing and extending toward other neurons and connecting.

Effects of Games on the Brain

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Emotion:

Building networks of neurons requires more than practice.

When our network connections are awash with emotion chemicals, synapse strength and the responsiveness of neuron networks can be dramatically changed

Emotion chemicals:

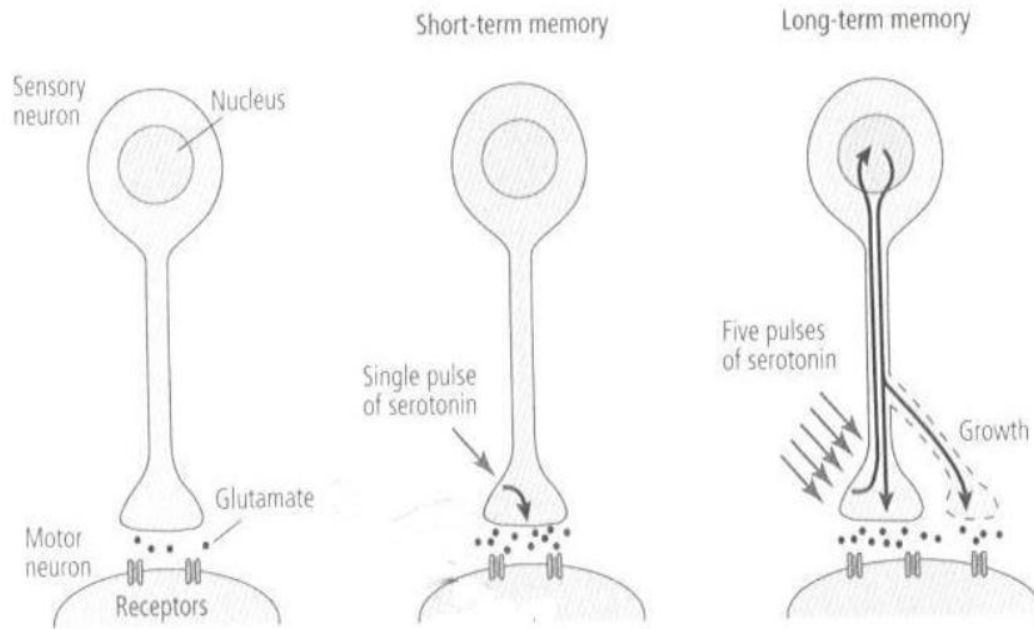
- adrenalin (fight or flight)
- dopamine (reward)
- serotonin (sleep and peace)

(Brembs, Lorenzetti, Reys, Baxter, & Byrne, 2002).

Effects of Games on the Brain

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ACTION OF EMOTION CHEMICALS



Why Games for Health?

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The face of gameplay: practice +emotion



New York Times: Robbie Benson, My Game Face

Why Games for Health?

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The face of gameplay: practice +emotion



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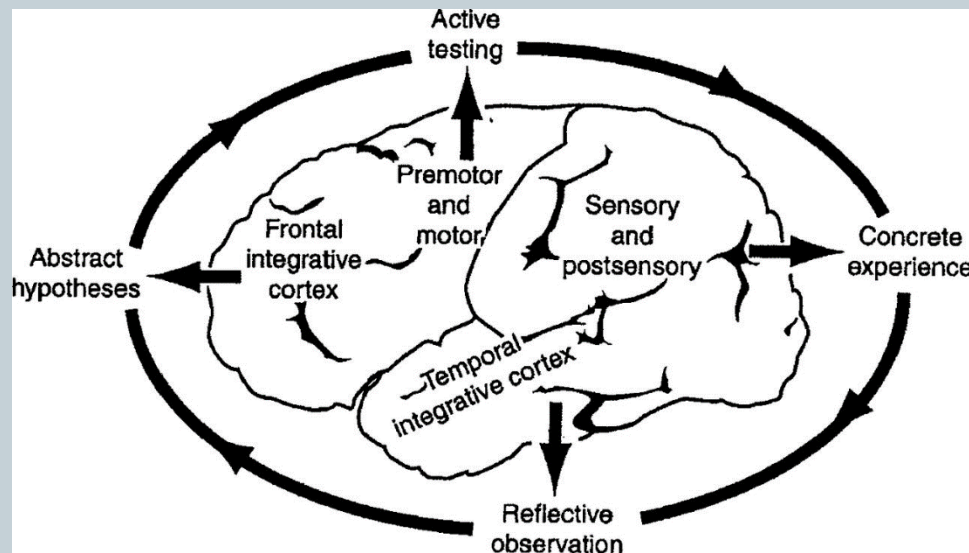


New York Times: Robbie Benson, My Game Face

Effects of Games on the Brain

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Don't Explain: eyes glaze over, gameplay does not explain
Build on Errors: games teach by forgiving failure
Engage the Whole Brain:



http://www.ascd.org/ASCD/pdf/journals/ed_lead/el200409_zull.pdf

Effects of Games on the Brain

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Schools are training kids for a world that no longer exists using methods that have failed.

Where is learning through engagement and discovery?



Game Research

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Cognitive Benefits of Gaming:

"Contrary to conventional beliefs that playing video games is intellectually lazy and sedating, it turns out that playing these games promotes a wide range of cognitive skills. This is particularly true for shooter video games (often called “action” games by researchers), many of which are violent in nature (e.g., Halo 4, Grand Theft Auto IV)."

The Benefits of Playing Video Games - Isabela Granic, Adam Lobel, and Rutger C. M. E. Engels
Radboud University

Cognitive Benefits of Gaming

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Shooter game players:

- allocate attentional resources more efficiently
- filter out irrelevant information more effectively

fMRI showed fronto-parietal network (control attention allocation) were less active during pattern detection tasks in non-gamers than in gamers playing shooter games

Bavelier, Achtman, Mani, & Föcker, 2012)

Cognitive Benefits of Gaming

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Play-fighting improves social/emotional competence:

"Social play...is a readily recognizable feature of childhood. In nonhuman animals, social play, especially seemingly competitive rough-and-tumble play or play fighting, has been the most studied of all forms of play..the understanding of the organization, development, and neural control of play in rats has provided a model with which to examine how the experiences accrued during play fighting can lead to organizational changes in the brain"

Rough-and-Tumble Play and the Development of the Social Brain, Sergio M. Pellis and Vivien C. Pellis, Department of Neuroscience, University of Lethbridge, Lethbridge, Alberta, Canada

Effects of Games on the Brain

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The beneficial effects of games go far beyond the well-established educational benefits.

The new gold standard in video game research is not mere patient education, but:

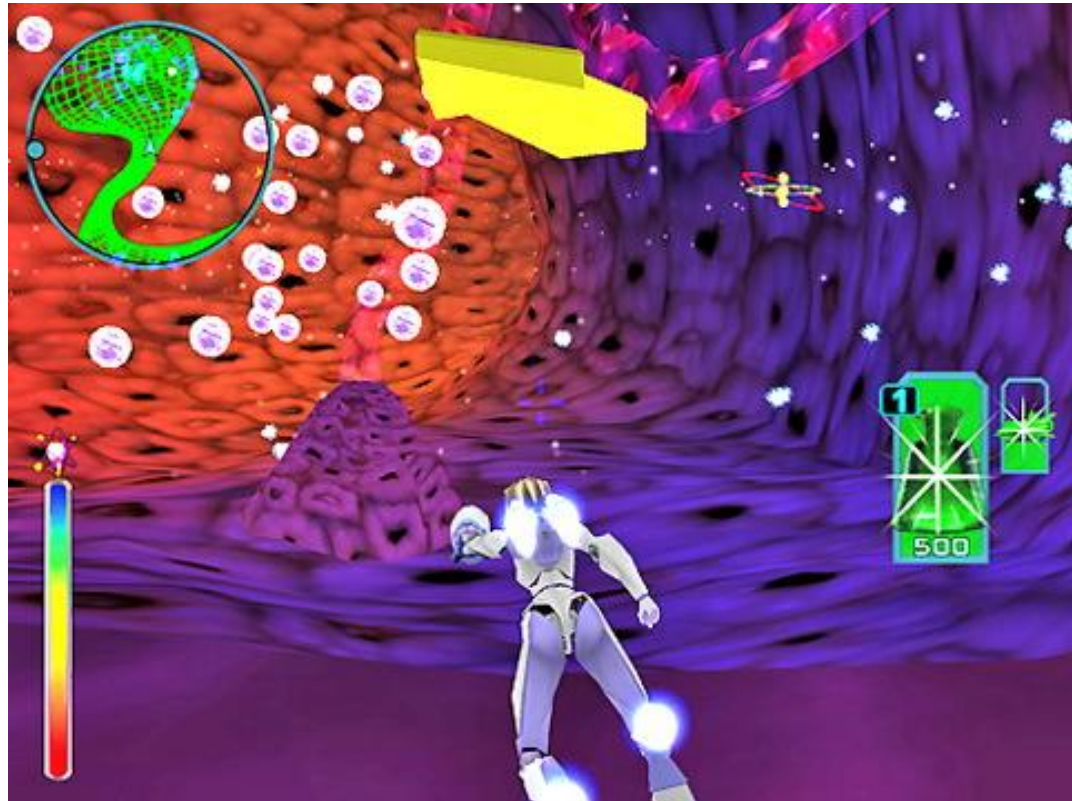
- **games as behavior change**
- **games as interventions**

Successful Games for Health

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- Cancer knowledge, medication adherence

Re:Mission



Successful Games for Health

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- CBT for teen depression

SPARX



Successful Games for Health

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- Pain Management



SnowWorld

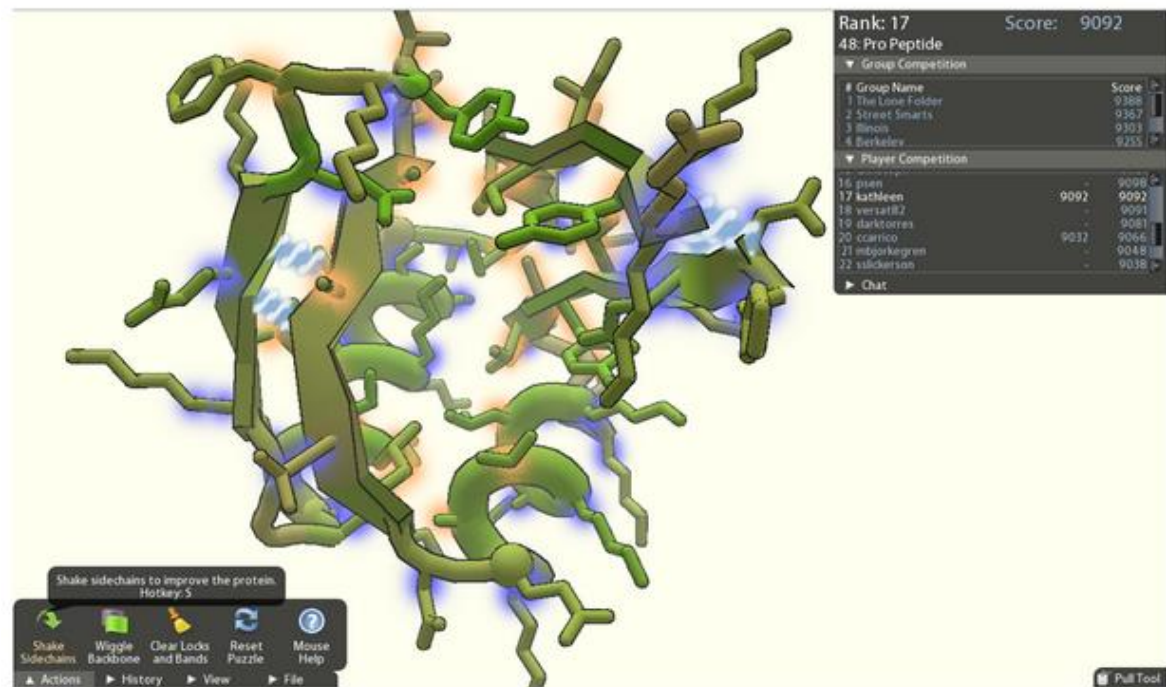


Successful Games for Health

- Curing disease with molecular biology

How gamers play Foldit to cure diseases

By Boonsri Dickinson | November 7, 2011, 4:32 PM PST



Gamers played a protein-folding game and solved an [AIDS riddle](#) that, well, stumped scientists for years. The gamers unlocked the key protein involved in the reproduction of HIV, scientists

Effects of Games on the Brain

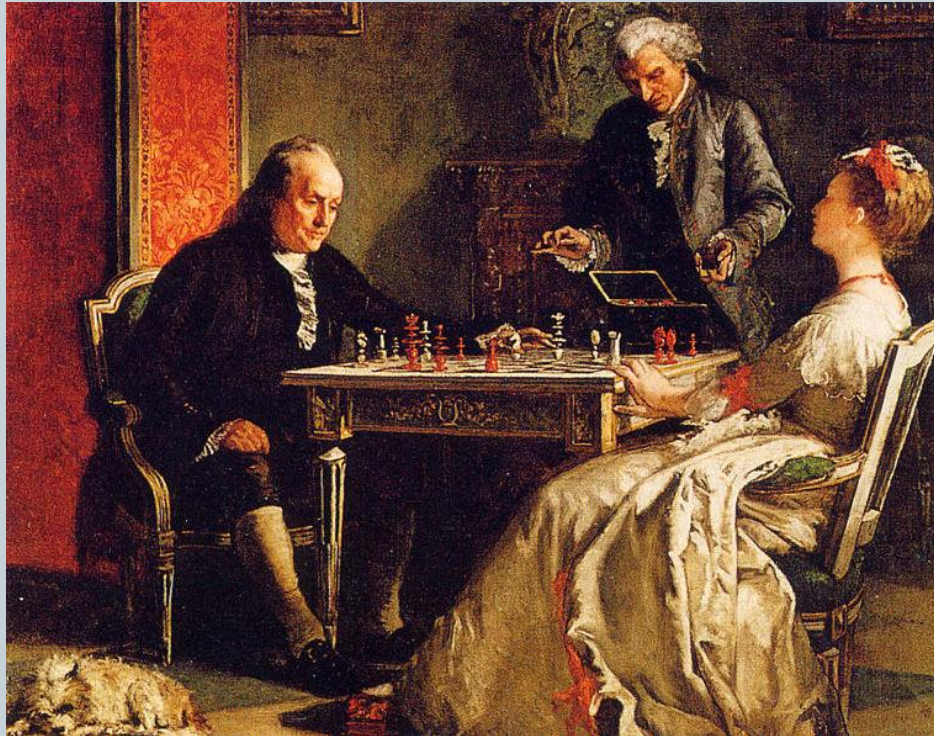
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Behavior change from gameplay known for 200+ years:

Effects of Games on the Brain

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Behavior change from gameplay known for 200+ years:



Effects of Games on the Brain

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"...the habit of not being discouraged by present bad appearances in the state of our affairs, the habit of hoping for a favourable change, and that of persevering in the search of resources."

—Benjamin Franklin, “The Morals of Chess

Effects of Games on the Brain

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Franklin was describing behavior change and psychological strengths:

Resilience *"...the habit of not being discouraged by present bad appearances in the state of our affairs,*

Future Orientation: *"hoping for a favourable change"*

Persistence: *"persevering in the search of resources."*

Franklin: *"...you must abide all the **consequences** of your rashness."*

Effects of Games on the Brain

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*"...you must abide all the **consequences** of your rashness."*

What do games do better than other forms of media or entertainment?

Effects of Games on the Brain

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*"...you must abide all the **consequences** of your rashness."*

What do games do better than other forms of media or entertainment?



Effects of Games on the Brain

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Games: directly experience the **consequences** of our own actions.

Unlike film, or theatre, or literature, where we indirectly experience the consequences of the actions of others-- yet even those passive, indirect consequences have profound effects on audiences.

Games: direct participation in choices and consequences

Linear Media: voyeuristic observation of choices and consequences

Effects of Games on the Brain

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Gamers are so eager to take the consequences of their actions that they rebelled against the popular video game Mass Effect 3 when it rewarded negative actions.

Players demanded and got a new alternate ending which properly punishes their negative actions.



Games For Behavior Change

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Adherence Problem:

What good is health education if people won't use it?

What good is care if patients won't follow instructions?

Two kinds of health apps:

- The kind you force on people and hope they use.
- The kind people seek out and want to use.
- People play games of their own volition

Weaknesses in Health Apps

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- Self-tracking health apps largely not working
- They lose 90% of users in first week
- Single-player, “dumb” feedback
- Does not “feel” like a game

Diabetes Game for Kids

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- Learning: Gameplay teaches kids strategies
- Action: The game simulates and models the actions needed for the child's health – learn by doing
- Challenge: consequences of real-world behavior felt in the game



Diabetes Game for Kids

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- Forgiving: failures can first be felt in the game world so they don't have to be felt in the real world.
- Experience the Future: success in game encourages success in real life = behavior change



Diabetes Game for Kids

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- Fear of the unknown – mastered in games
- Fears cause paralysis- a source of non-adherence
- The game is a safe place to face and master fears



Games for Smoking Cessation

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- Psychological aspect of smoking very powerful
- Disrupt cravings for several minutes and you can stop a relapse
- Artificial Intelligence to anticipate cravings
- Effective distractions to disrupt cravings



Games for Preventing Relapse

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- Physical actions can help with relapse prevention
- Can gameplay that fights the addiction also strengthen the player's fight against addiction?



Games for Health Education

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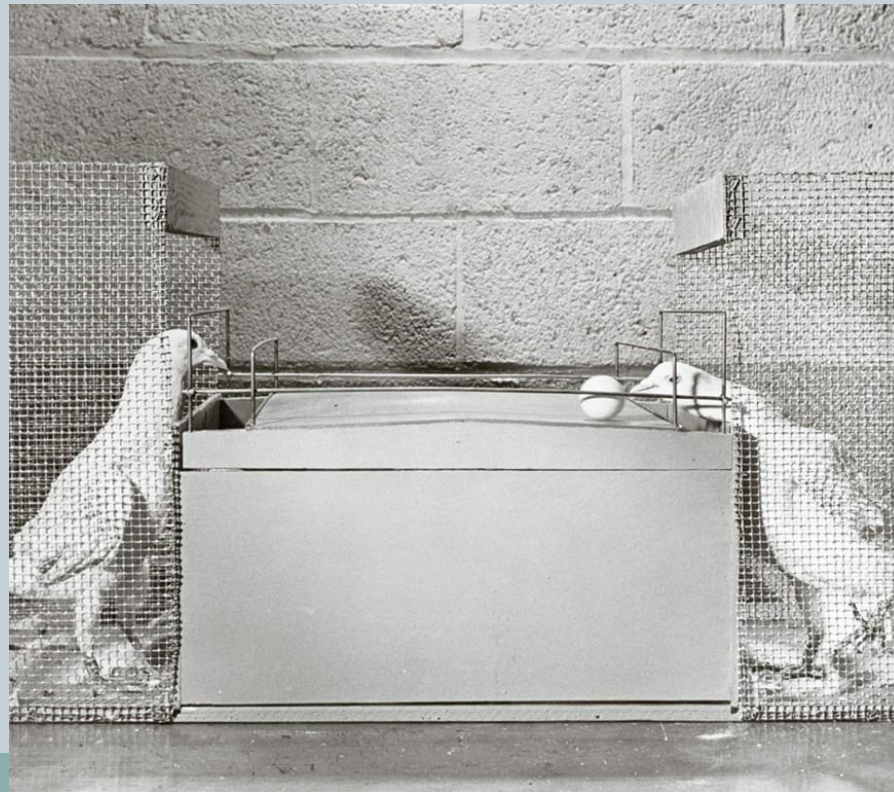
- Nintendo DS with augmented reality
- Lets kids explore their world in novel ways
- Learn about public health issues in a game format



Games for Assessment

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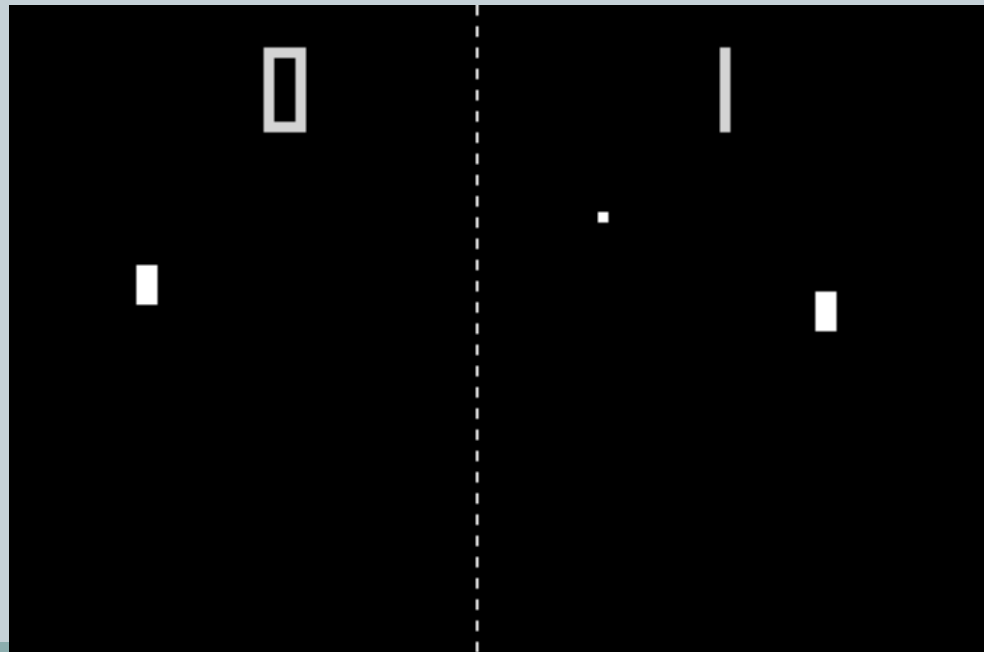
- Animal models don't always map well to humans
- Are these just species differences?



Games for Assessment

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- Or can we build a gameplay environment that allows validated animal assessment tests to work in humans?



Game Play = Scientific Method

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Game play as the scientific method:

- Players confront an unknown phenomenon
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- Validate / revise
- Repeat

Babies As Game Designers

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- Babies drop their focus from stimulus items whose complexity is either very low or very high.
- The only thing that retains the focus of infants are stimulus items are “just right.” (University of Rochester)



Babies As Game Designers

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- Powerful evolutionary adaptation.
- Waste of precious cognitive resources:
 - Spending time on previously learned material
 - Material that is unlearnable
- Babies know what is too boring or too challenging
- Biologically programmed to steer away from it.

Babies As Game Designers

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- This is exactly the game design process
- Make a game too easy, players grow bored and quit.
- Make the game too challenging, players grow frustrated and quit.
- The secret is a manageable stress:
- Appropriate challenge, and appropriate resources to meet that challenge.

Why Do Games Engage?

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Eustress:

the positive cognitive response to stress that is healthy, or gives one a feeling of fulfillment or other positive feelings

Challenge -> Stress -> Mastery

Why Do Games Engage?



Eustress:

Challenge -> Stress -> Mastery

Eustress: Positive or curative stress

Performance Stress Curve

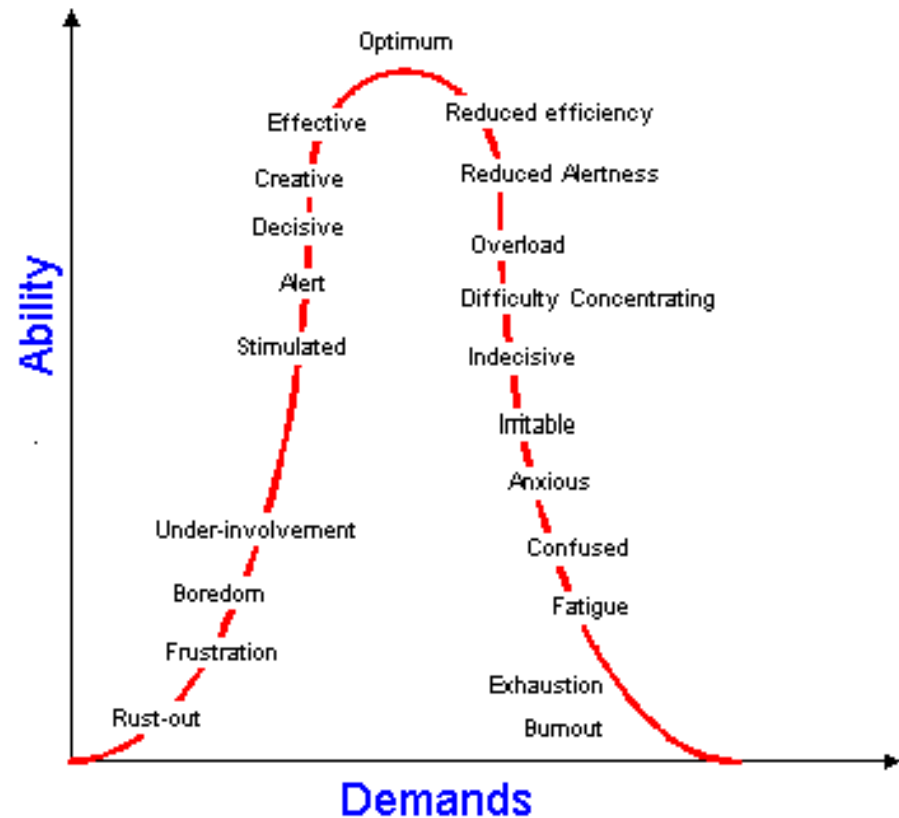


Why Do Games Engage?



Eustress:

The Stress Response



Moral Panics / Scapegoating

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Questions for those seeking to prove game “addiction.”

1. Compare and contrast the agony of physical withdrawal from addictive substances in the bloodstream with the alleged withdrawal from non-chemical, non-substances that are not in the bloodstream.

Moral Panics / Scapegoating

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Questions for those seeking to prove game “addiction.”

2. Can you make the same claims of “addiction” to:

- Music?
- Love?
- Sex?
- Work?
- Food?
- Children?
- Shopping?
- Exercise
- etc.?

Moral Panics / Scapegoating

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Questions for those seeking to prove game “addiction.”

3. Substance abuse addiction research can usually show a dose- response relationship.

Can video game “addiction” research show a dose-response relationship?

Montessori Principles as Gameplay

78

- **Human Tendencies : Interface**
 - Exploration
 - Purposeful Activity
 - Manipulation of the Environment
- **Prepared Environment : Game World**
 - Facilitates activity
 - Removal of the extraneous
 - In proportion to needs
- **Teacher (App) as Observer : Artificial Intelligence**
 - Don't lead by the nose
 - Artificial Intelligence to adapt

Contact Us:

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Daniel Greenberg
President
Media Rez
www.media rez.com
contact@media rez.com

