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 Platform: All Platforms Category: -- All Categories --  
 Released: at any time With At Least: 20 reviews Sorted: best to worst  
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Game List			
	N64	<b>The Legend of Zelda: Ocarina of Time</b> Nintendo, 1998	<b>97.48%</b> 25 Reviews
	Wii	<b>Super Mario Galaxy</b> Nintendo, 2007	<b>97.46%</b> 77 Reviews
	Wii	<b>Super Mario Galaxy 2</b> Nintendo, 2010	<b>97.07%</b> 53 Reviews
	PS3	<b>Grand Theft Auto IV</b> Rockstar North/Rockstar Games, 2008	<b>97.01%</b> 60 Reviews
	DC	<b>SoulCalibur</b> Namco, 1999	<b>96.94%</b> 24 Reviews
	PS3	<b>Uncharted 2: Among Thieves</b> Naughty Dog/SCEA, 2009	<b>96.41%</b>

**GATE** Game research for training and entertainment

# Instructional level design

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**GATE** Game research for training and entertainment

## Outline

Level design

Serious game design

The experiment

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## ILD in Super Mario Bros 1





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## ILD in Super Mario Bros 1



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## Games revolve around learning

Games throw up hurdles, they are fun because you learn how to overcome these (and master them)

Levels should be designed in such a way as to accommodate this learning as smoothly as possible

The following examples feel natural when you play them, but are not randomly placed, try to think as a designer!



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## Level Design in Super Mario Galaxy 2



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## Learning Cloud Mario



# [Redacted]



# Level Design in Super Mario Galaxy 2



# ILD Heuristics: novelty



Keep introducing new features all through the game, don't present everything in the beginning, lest the latter part of the game becomes a grind

# ILD Heuristics



Let's delve a little deeper into the psychology of games...

## ILD Heuristics: learning



Object to be learned: platform

## ILD Heuristics: enemy placement



Note: Enemies are at bay

## ILD Heuristics: incentives



Coins provide a bonus to the player and thus act as a natural incentive

## ILD Heuristics



Likewise, the star bits act as an incentive to have the player ride the platform out to the bottom

## ILD Heuristics: cueing



Exclamation mark draws attention (signposting)

## ILD Heuristics: cognitive guidance



## ILD Heuristics: color coding



Important platforms have different color from the rest

## ILD Heuristics



Color coding consistency throughout the level

# The science of game/level design

Perceptual / brain sciences

Which objects/colors do players look at first?  
How do you lure them somewhere?

Cognitive psychology

Where do I place which enemies?



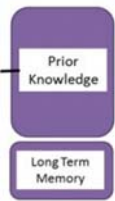
Learning sciences

How do players learn in games?

Emotion science

What is rewarding?  
How do I engineer fun?

# Activating prior knowledge



That's why it was good to color code: because it activates prior knowledge. The player will effortlessly remember some of the characteristics

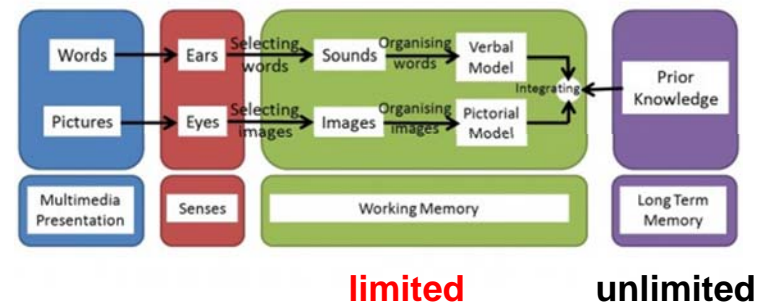


# Foreshadowing

If a puzzle, or level layout, is too big/complex to comprehend at the moment the player needs to, start feeding them bits beforehand



# How do players learn?



(Mayer & Moreno, 1998, 1999, 2003...)

Prince of Persia: The Warrior Within does the same thing

Puzzlesolving of the npc foreshadows the actions of the player



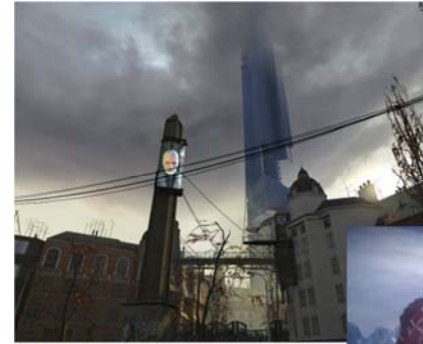
More subtly, Metroid/vania games let you know where to go, before you can



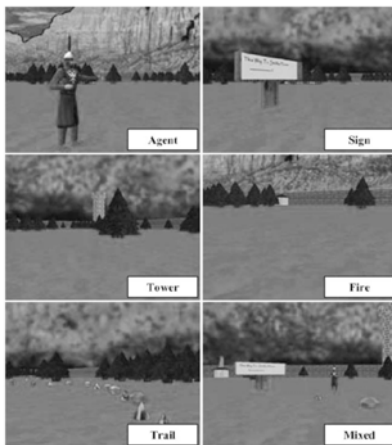
## Where should I go next?



## Background waypoints



## Guidance cues experiment



Steiner and Voruganti (2004)

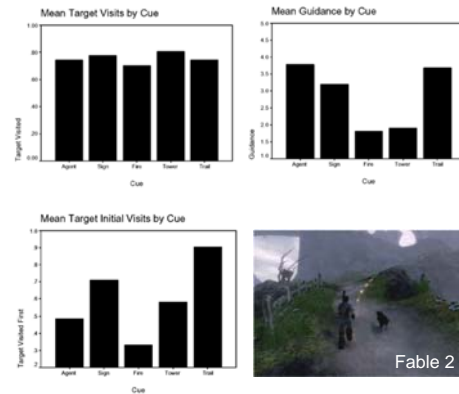


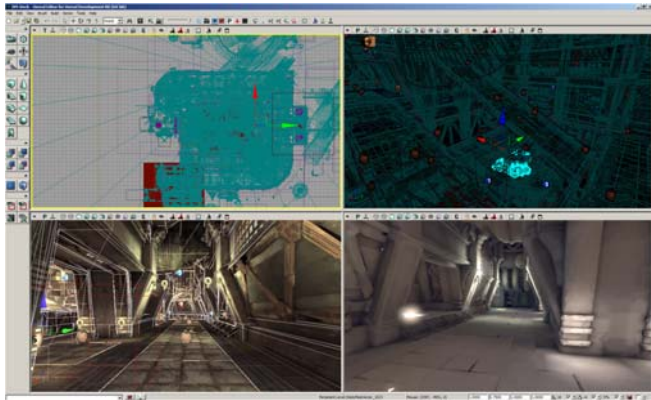
Table 2

## Guiding indoors



Our eyes are drawn to areas of high contrast, these denote shape borders





'Squint mode' to determine what draws the most attention



To an extent, most (older) games already perceptually guide the player well, albeit unintentionally



More theoretically, guidance cues are important when a player is overloaded by too much information at the same time

Cognitively – too much is happening at the same time to separate relevant from irrelevant information

Perceptually – irrelevant information is more salient than irrelevant information

## Perceptual cues

Newer games also have highly detailed backgrounds



World is so salient, that it becomes impossible to distinguish between objects you can use and background

## Cues

Or to signify the enemy boss' weak spot, which you can hit to inflict massive damage



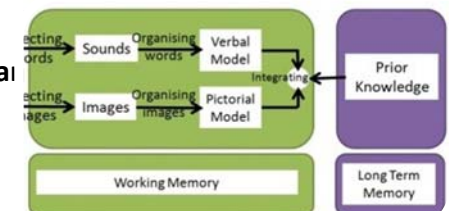
## Enemies

These visual cues can in turn be used for guidance, too



*“Good games offer players a set of challenging problems and then let them solve these problems until they have virtually routinized or automatized their solutions. Then the game throws a new class of problem at the players (sometimes this is called a “boss”), requiring them to rethink their now taken-for-granted mastery, learn something new, and integrate this new learning with their old mastery. In turn this new mastery is consolidated through repetition (with variation), only to be challenged again. This cycle has been called the “Cycle of Expertise” (Bereiter & Scardamalia 1993); it is the way anyone becomes expert at anything worth being an expert in.”*

J.P. Gee, Good video games and the mind, Phi 2005





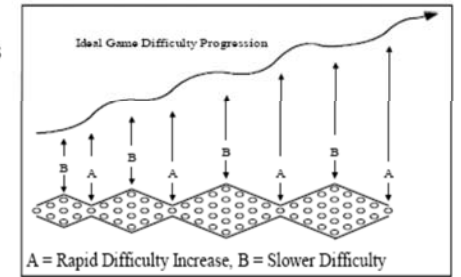
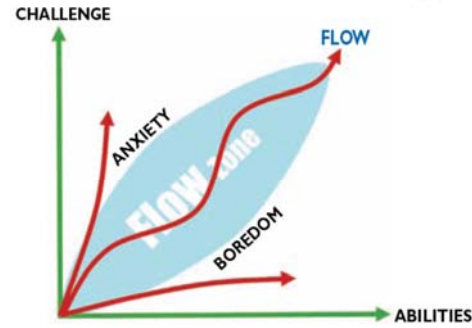
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## Enemies



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## Ideal game difficulty progression

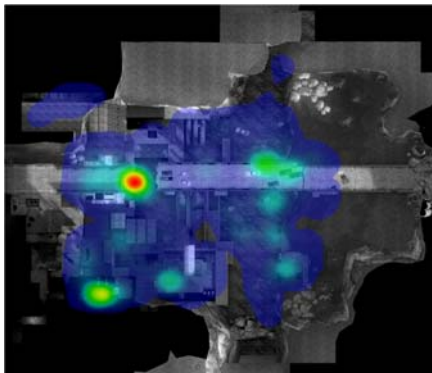


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## Playtesting

**Be prepared to tweak your game afterwards**

**Let other people play your game, they don't know what you know! (Other players are idiots.)**



HL2 death map



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## Serious game design

## Why serious games?

- Given that games revolve around learning to overcome obstacles, it's easy to see how they can be used to teach
- They're also a lot more fun than learning from a textbook
- Can be used to teach a lot more than regular textbooks

## Why serious games?



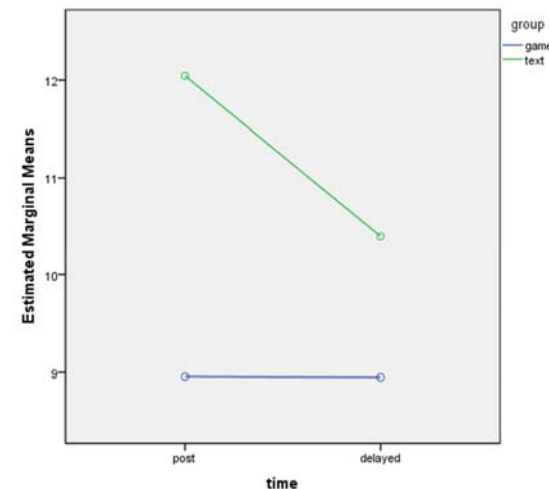
## Serious games effectiveness

- However, evidence for effectiveness is lacking
- Literature study:
  - ~ 60% is successful to varying degrees (but more often than not with no control group)
  - (Wouters, Van der Spek & Van Oostendorp, 2009)

In fact, we tested our game Code Red Triage, comparing it to giving the information on a powerpoint presentation



## Serious game effectiveness



Game imposed significantly higher cognitive load  
 $F(1,46)=25.956$ ,  
 $p<0.001$

Cognitive load is negative predictor for test score  
 $B=-1.969$ ,  $p<0.001$

So we have our work cut out for us

In fact, that's what my PhD research is about

**CODE RED TRIAGE**

- **COgnition-based DEsign Rules Enhancing Decisionmaking TRaining In A Game Environment**

So we're trying to discover if we can improve serious game design by looking at good instructional entertainment game design



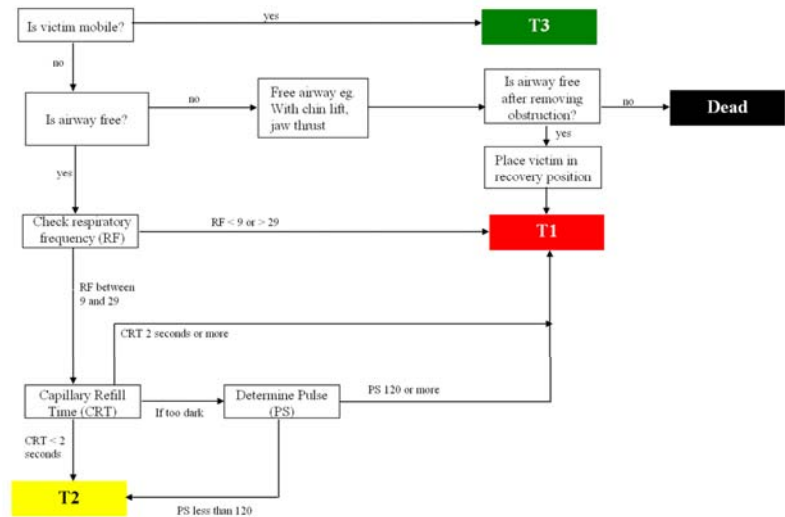
We don't really **know** what makes a good designed game

Games teach their instructional material efficiently (high flow)

Those that do this the best (create flow-learning state), get the highest scores

Games with the highest scores sell more

Games that sell more, get copied



# Experiments

Tests:

Paper pre and posttest with text and image based procedural questions

Mental model elicitation by conceptual relatedness

Presence / engagement questionnaire



# Experiment 1: cueing



# Experiment 1: results

No effects on paper tests, mental model construction significantly worse in cueing condition!  
 What works in entertainment games, makes learners lazy?

Next experiment:



# Cognitive load

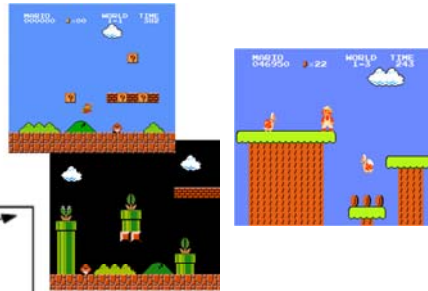
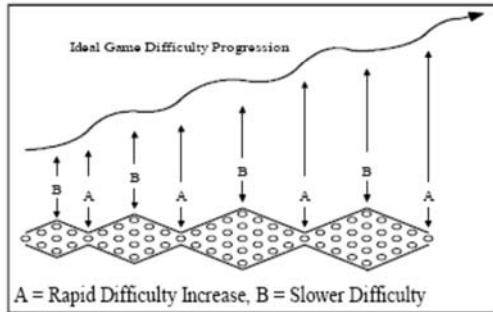
Remember:



Games have higher cognitive load, makes it difficult to separate relevant from irrelevant information

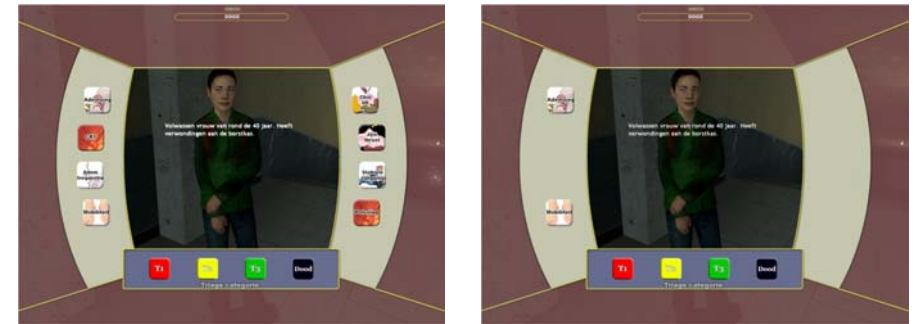


Remember:



Regulating the information presentation rate could help automate the material...

but could also lead to inadequate mental models, based on incomplete data; why A, but not: why NOT B



No results; still running

8 students game design participated

Early indication: progressive buildup of complexity more enjoyable, probably also better learning

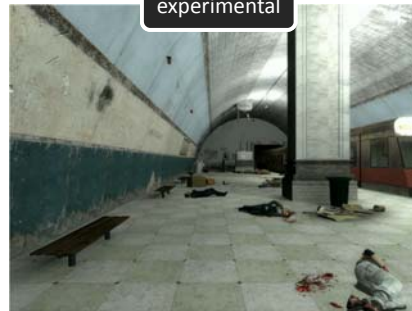
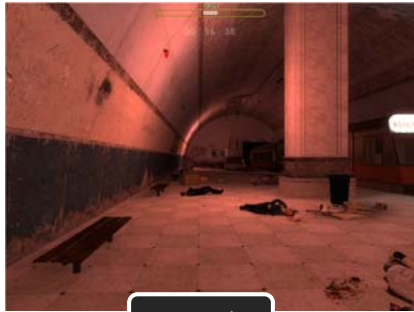
So far, we tried to catch up with traditional learning by diminishing problems with cognitive load in games

But can we use game specific features to improve learning?

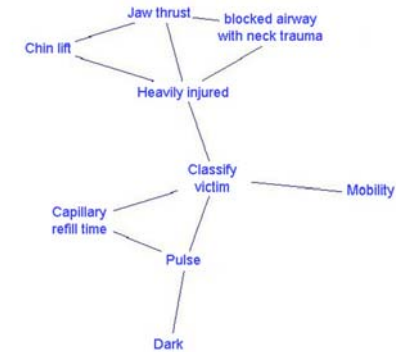
Games have narratives (sort of)

- Things *happen*
- People remember surprising events
- Can this be used in training?

## Experiment 3: events



## Experiment 3: different tests



Ended with direct questions pertaining to the information learned with the events (if light then, if dark then)

## Experiment 3

### High scores:

Jurgen Buisman	1278	(narr)
Robin van Olst	1239	(cont)
Benjamin Koelewijn	1094	(cont)
Daniel Faustino	1066	(cont)
Kevin Vriens	1046	(narr)
Alexandru Dimitru	1039	(narr)

Mean: 736.78

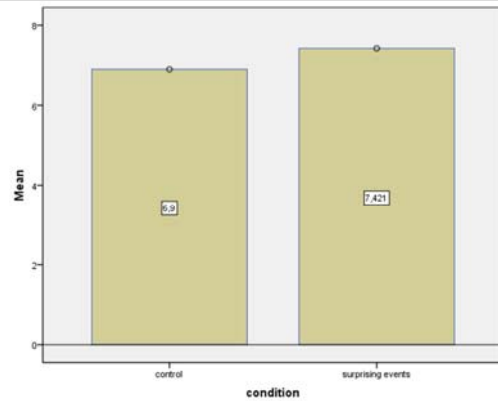
Std Dev: 219.84

## Experiment 3

### No significant differences:

- Paper tests
- Engagement questionnaire
- Score
- Perceived difficulty
- Enjoyment

⊗ ... That's science!

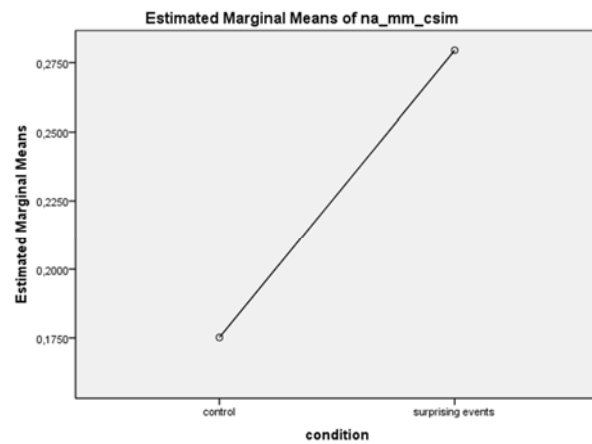
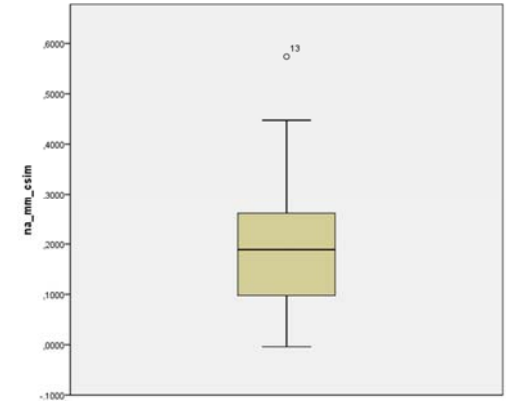


The experimental condition did score better, but because the control group did so well too, this didn't reach significance

However, the association test is 'nearly significant'

$F(1,38) = 3.249, p=0.079$

Upon closer inspection  
In control group



Covariates appearing in the model are evaluated at the following values: voor\_mm\_csim = .065073

**ANCOVA  $F(1,37) = 5.473, p < 0.05$**