
SCORE<1> HI-SCORE SCORE<2>
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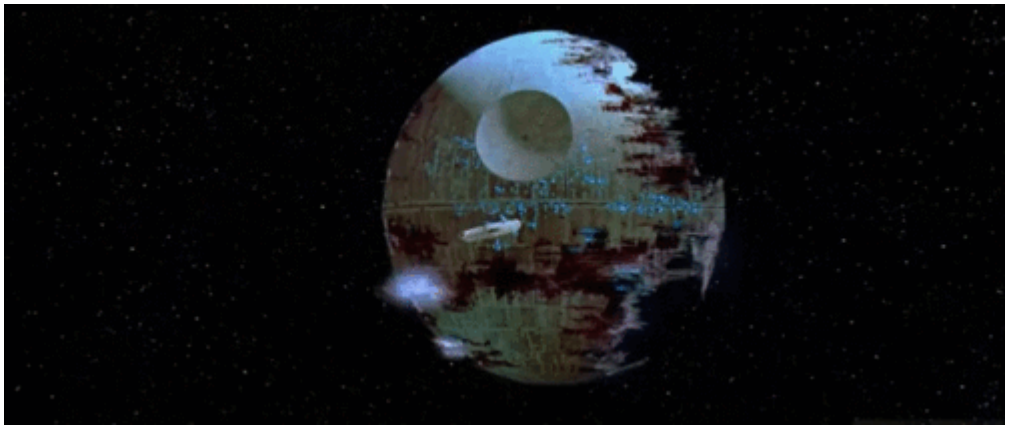
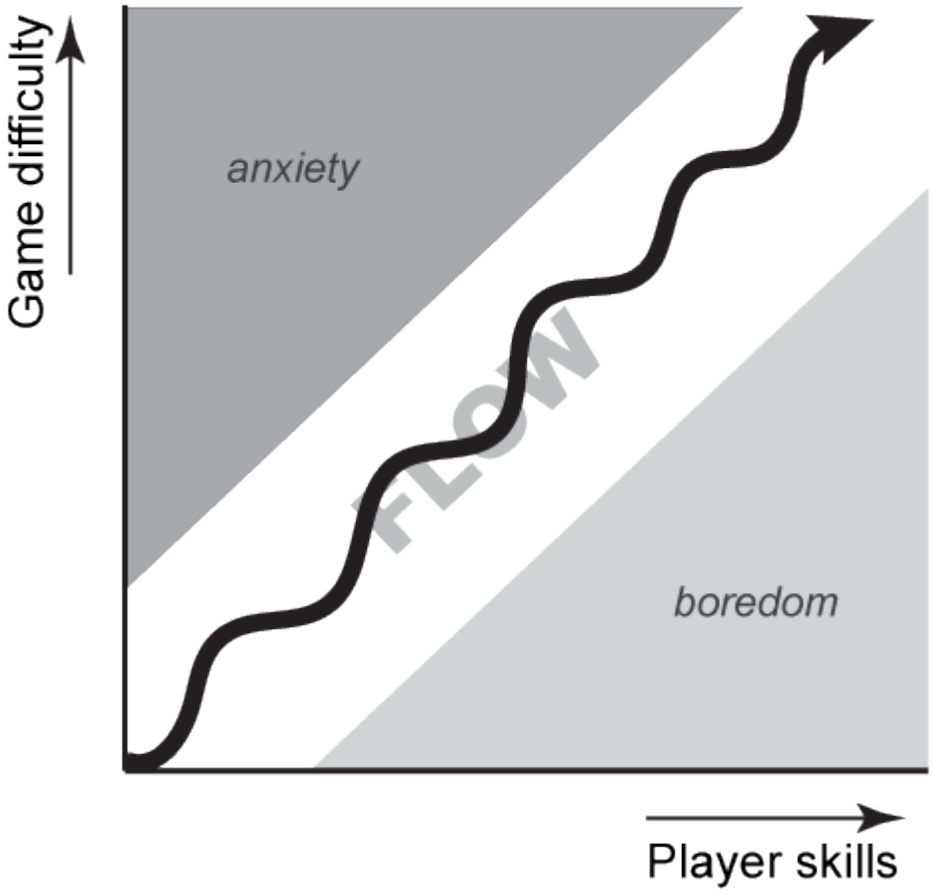
3
CREDIT 04

Desperate last save



Flow theory



Though most importantly

Adaptivity in Games

dr. Erik van der Spek

TU/e Technische Universiteit Eindhoven University of Technology

Where innovation starts

Designing intelligence in interaction

- Space Invaders not very intelligent, though it appeared to be
- It had (though not intentional) an ‘understanding’ of the skill level of the player and adapted the challenge accordingly

  (intelligent interaction)
- However, all players encountered the same game

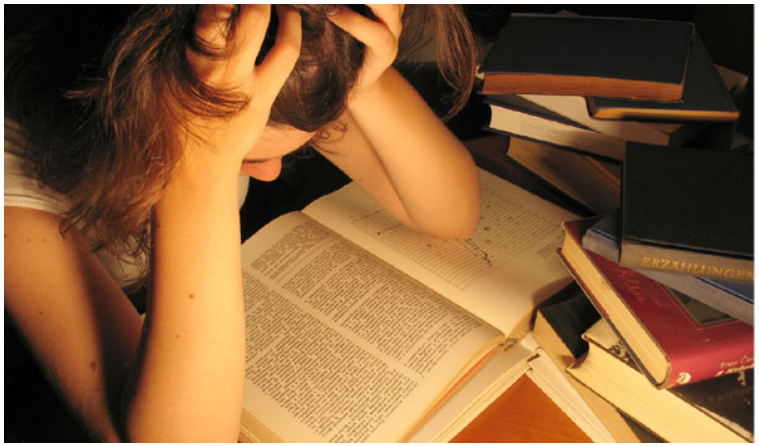
Games as assessment

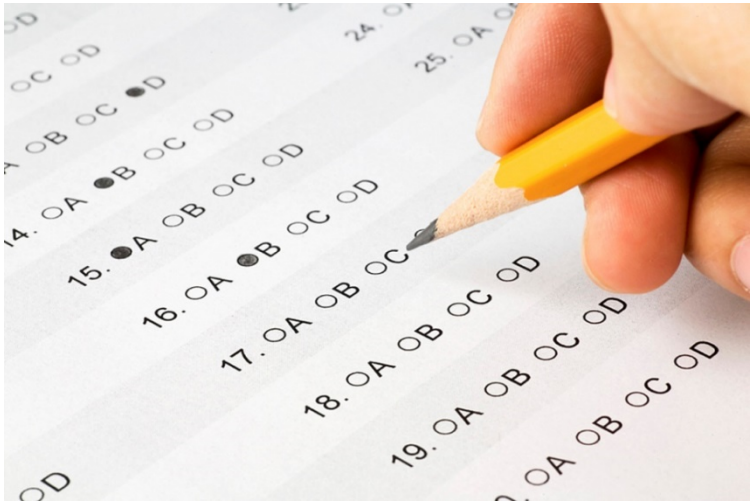
- **Progression / state changing systems contingent on user input are in a sense, assessment systems**

- **Games also add playing**

What is playing?

Learning and assessment

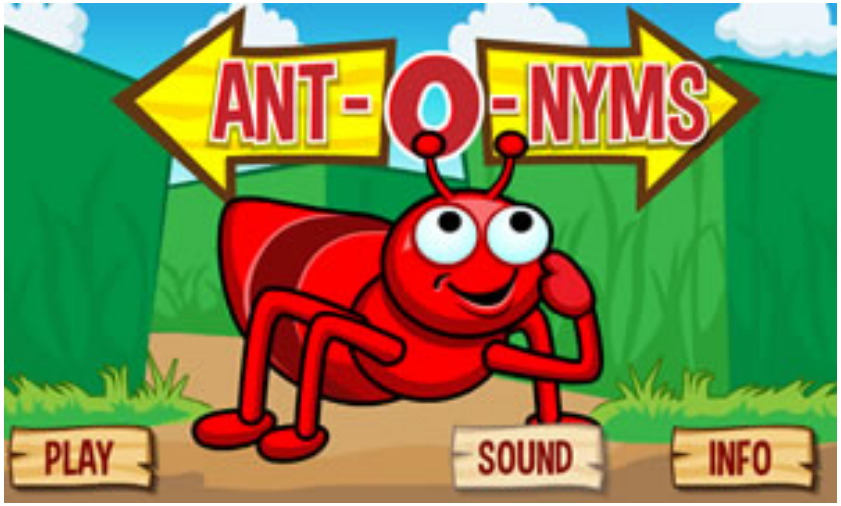




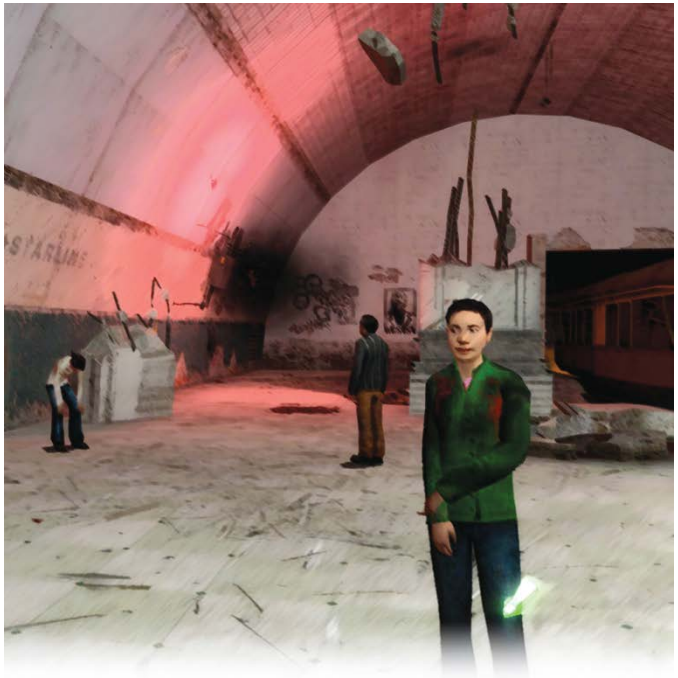
Tutor systems

- Games are tutor systems
- They stimulate and scaffold active, autonomous learning
- And test whether the player understands it
  - But, understands what?

Serious games

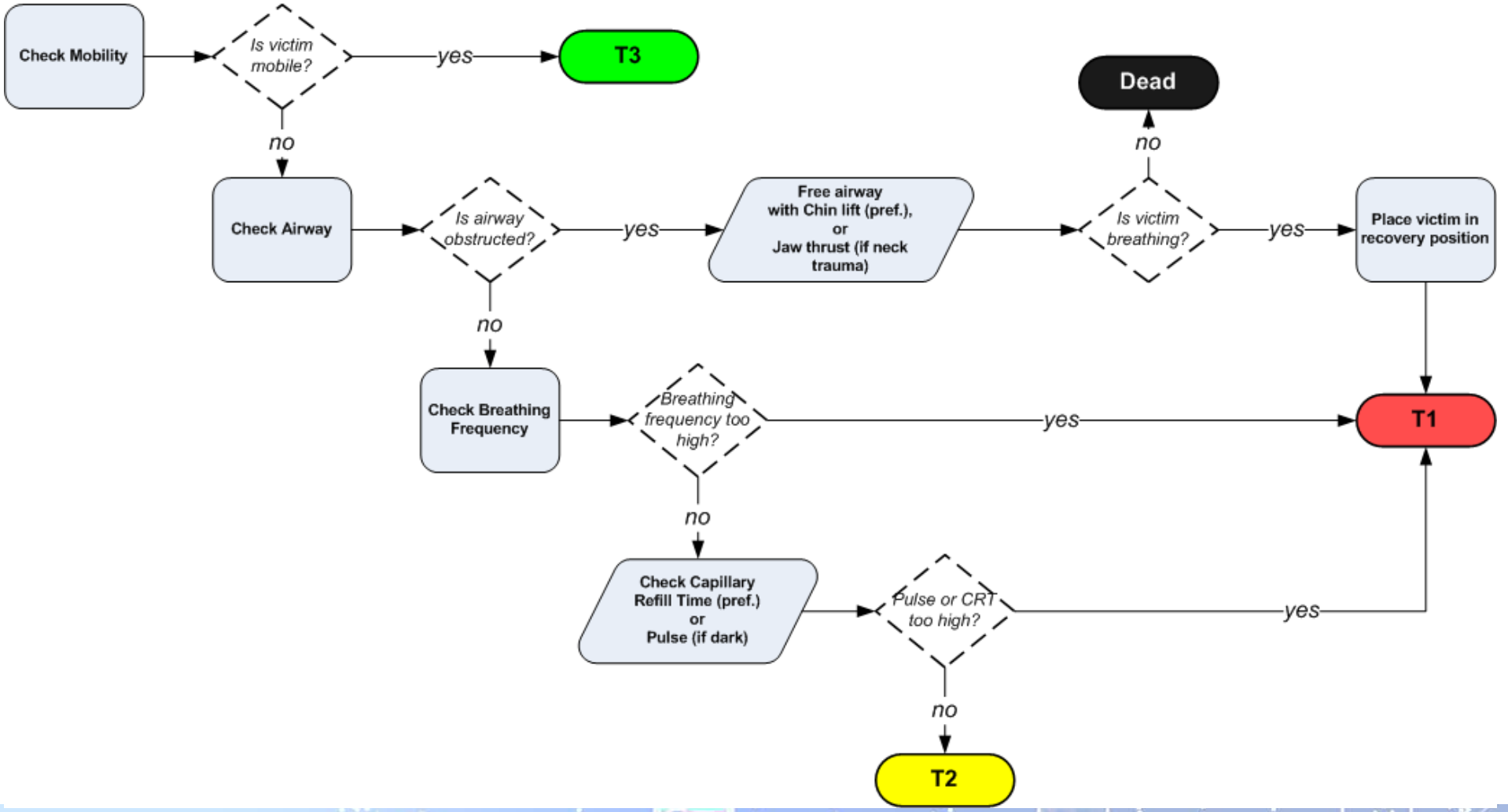


Experiments in serious game design



Code Red Triage

Triage

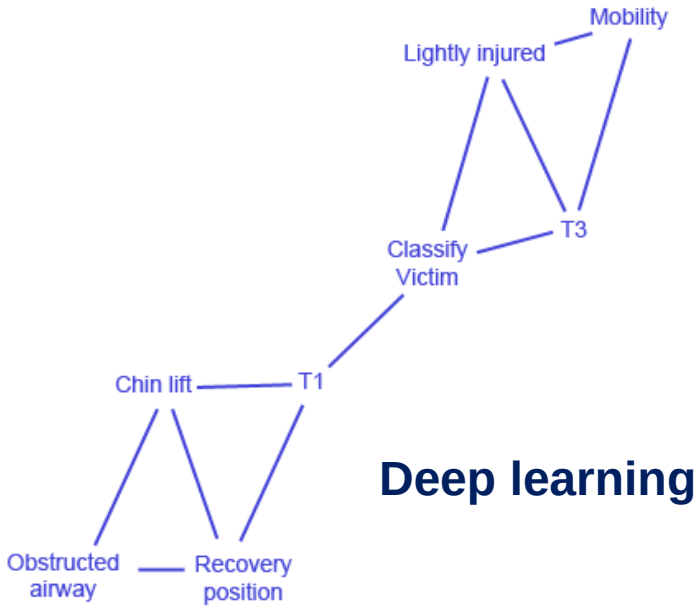

Check Mobility
Is victim mobile?
yes
T3
no
Check Airway
Is airway obstructed?
yes
Free airway with Chin lift (pref.), or Jaw thrust (if neck trauma)
Is victim breathing?
yes
Place victim in recovery position
no
Dead
no
Check Breathing Frequency
Breathing frequency too high?
yes
T1
no
Check Capillary Refill Time (pref.) or Pulse (if dark)
Pulse or CRT too high?
yes
no
T2

Code Red Triage

What did we test?

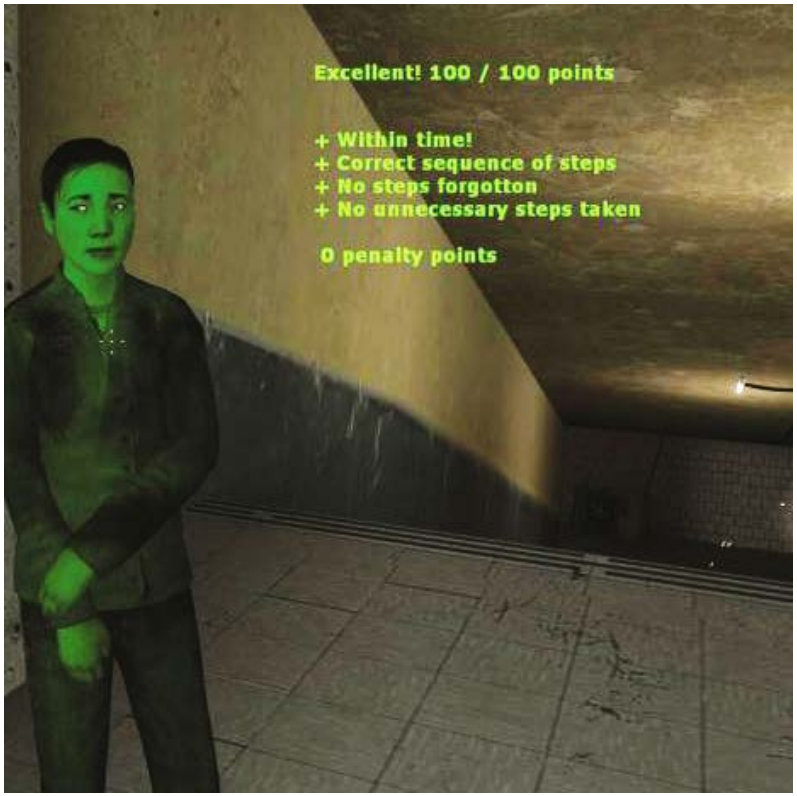
- **Three measures of learning:**
  - Surface learning (paper knowledge test)
  - Deep learning (structural assessment)
  - In-game score

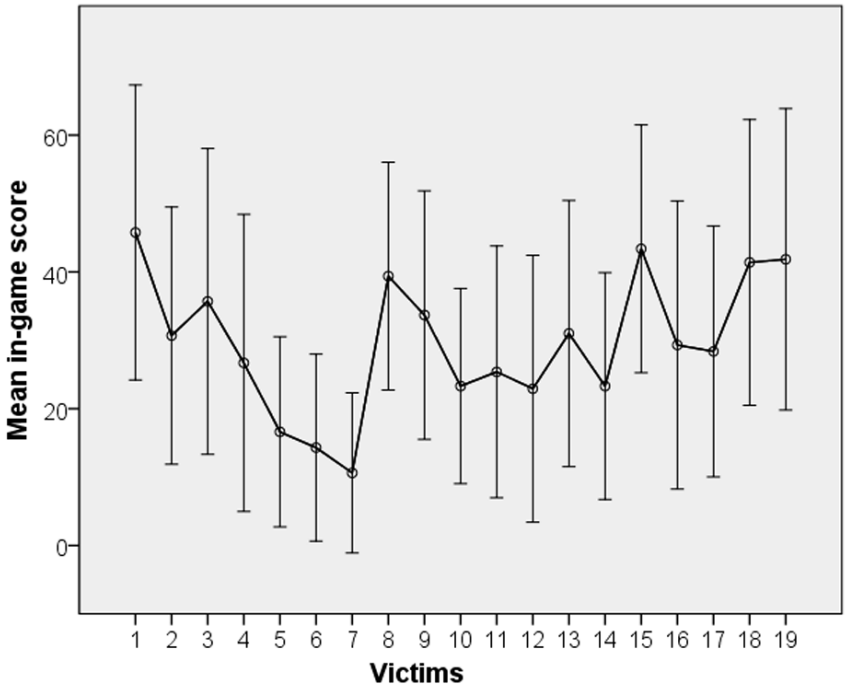
- **Affective questionnaires**
  - Presence/Engagement
  - Enjoyment rating
  - Difficulty rating



Deep learning

In-game score

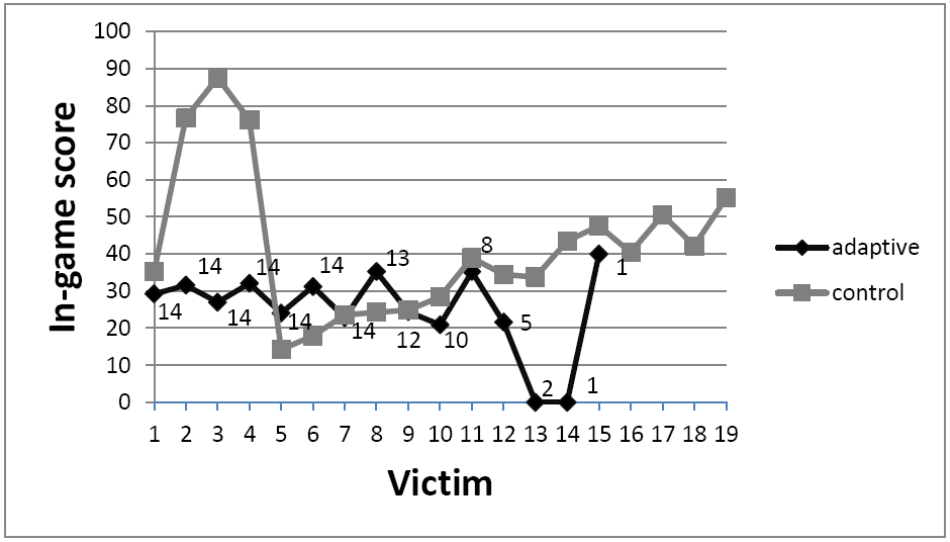


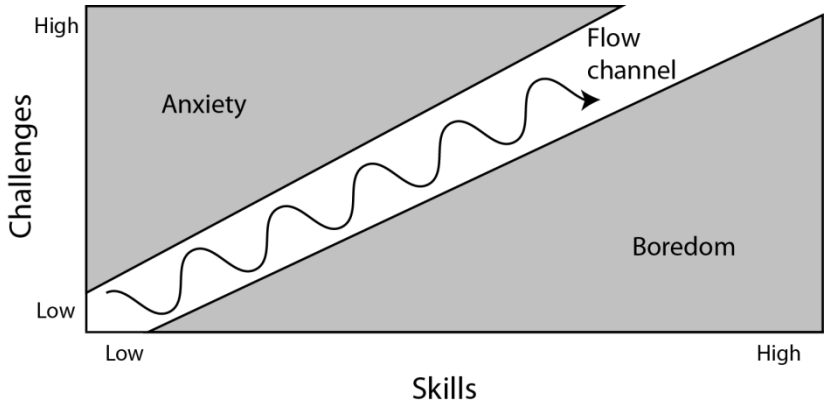


van Oostendorp, H., van der Spek, E.D., & Linssen, J. (2013). Adapting the complexity level of a serious game to the proficiency of players. In *European Conference on Games Based Learning* (p. 553).

Adaptation

- Difficulty progression based on proficiency
- Two graphs significantly different $p < 0.001$
- Adaptive more in line with Flow theory





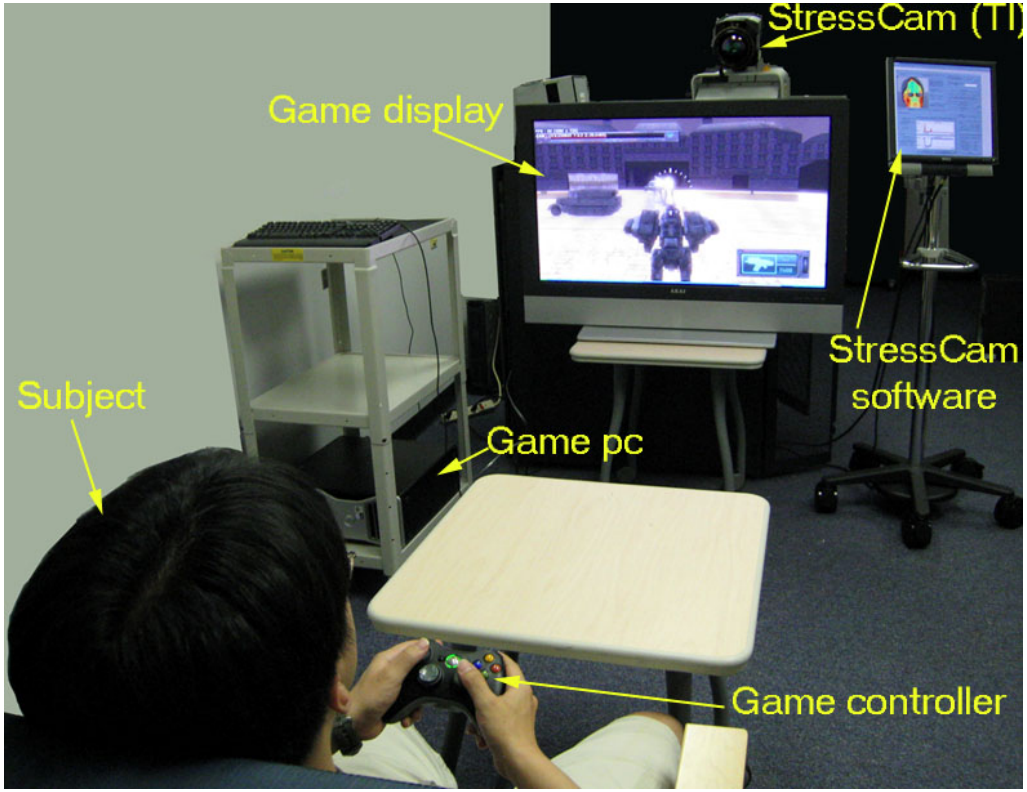
More efficient not more fun

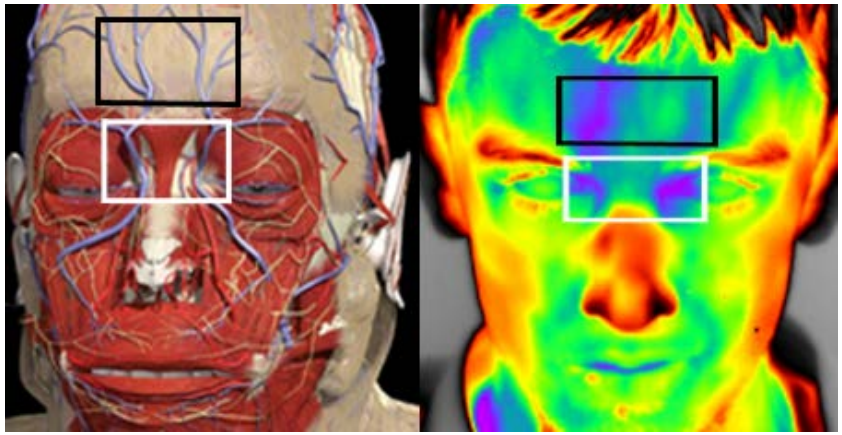
- Adaptive condition finished game 30-50% faster
- So adaptation was significant ($p < 0.001$, $d = 1.86$)
- But no difference on reported engagement (not presence/engagement, not enjoyment, also not perceived difficulty) $F < 1$

Adaptation

- Two types of adaptation
  - Online (real-time)
  - Offline (in between sessions, not really intelligent, but data can be used to train AI or improve settings in-game)
- Two types of assessment
  - Covert (stealth) assessment
  - Overt assessment

StressCam





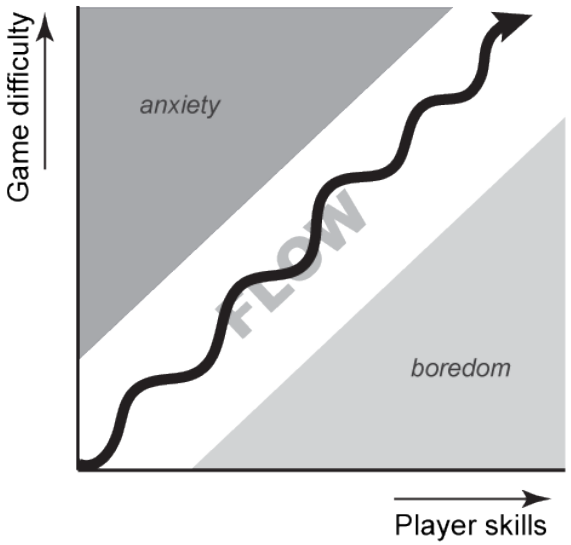
Yun, C., Shastri, D., Pavlidis, I., & Deng, Z. (2009, April). O'game, can you feel my frustration?: improving user's gaming experience via stresscam. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2195-2204). ACM.

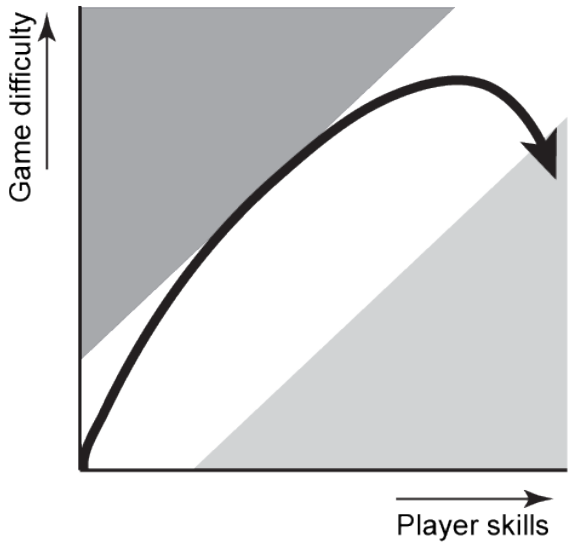
StressCam

- 3 Difficulty levels: Easy, Normal, Hard
- Conditions were either a static difficulty level, or a dynamic difficulty adaptation
- Majority just preferred the easy setting

Dynamic Difficulty Adjustment

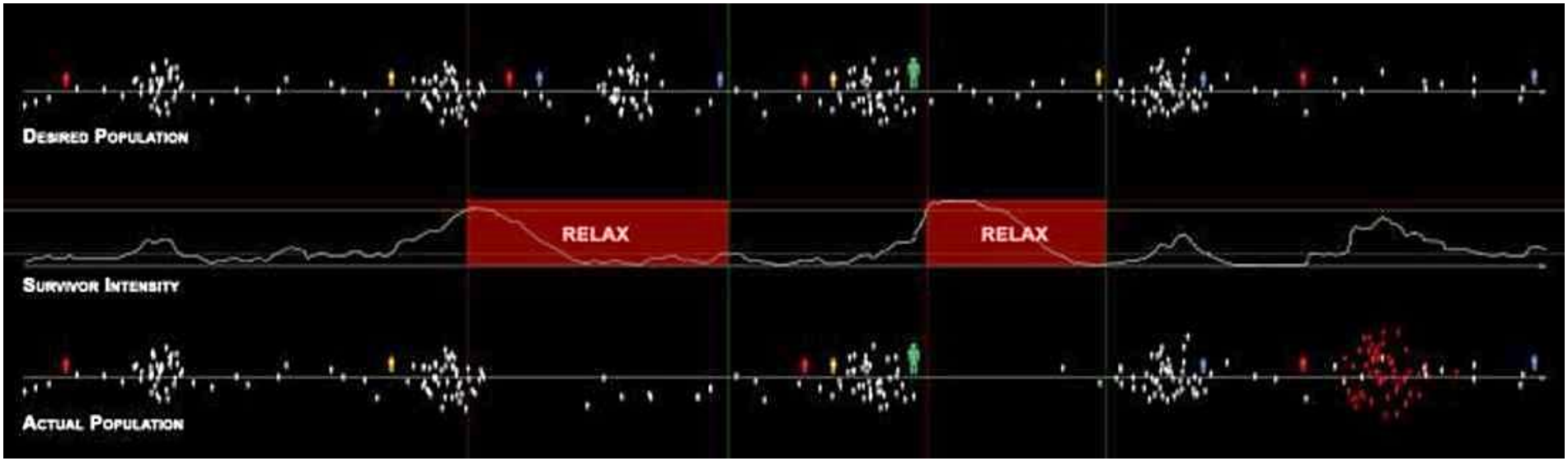
Not challenge but overcoming challenge



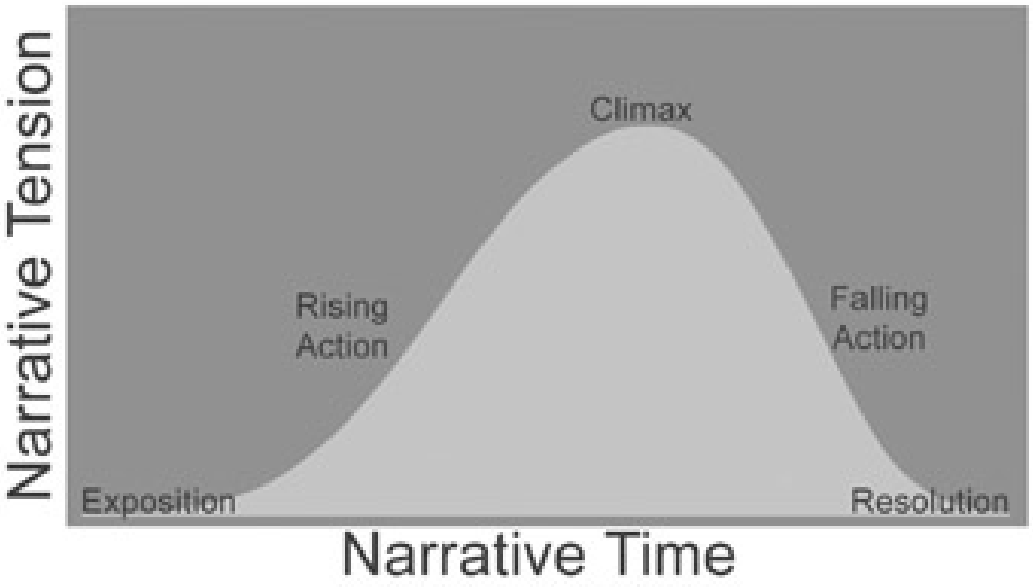


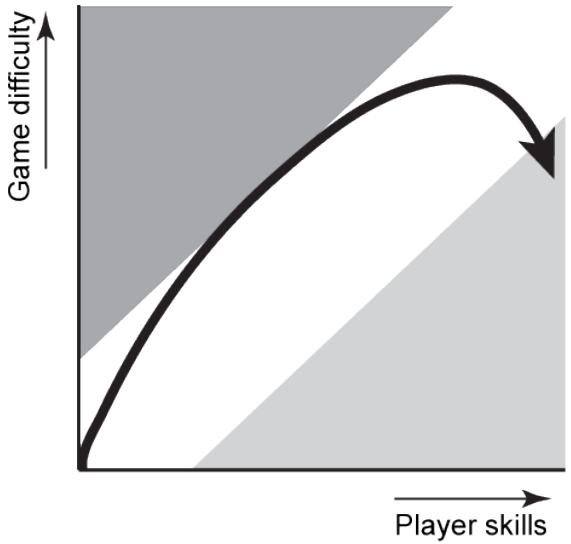
AI Director

AI Director


Desired Population
RELAX
RELAX
Survivor Intensity
Actual Population

3 Act Dramatic Arc





Denouement

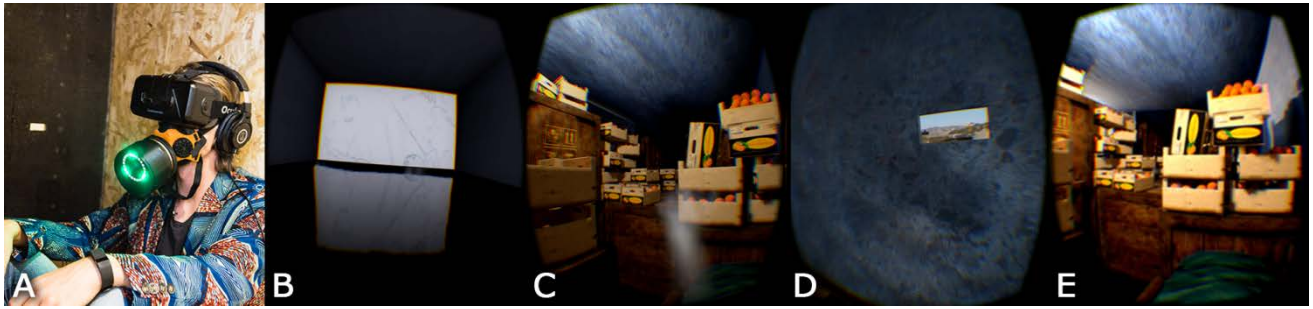
- The denouement is important
- For tension relief and catharsis

- But maybe also for learning

A Breathtaking Journey

A breathtaking journey

Game design for persuasion



- **The quieter moments where nothing happened were the moments where players started reflecting and adding things to the story**

Kors, M. J. L., Ferri, G., van der Spek, E. D., Ketel, C., & Schouten, B. A. M. (2016). A Breathtaking Journey.: On the Design of an Empathy-Arousing Mixed-Reality Game. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play* (pp. 91-104). ACM.

Quiet, boring?


VERSE 1
4984164

Attention cues

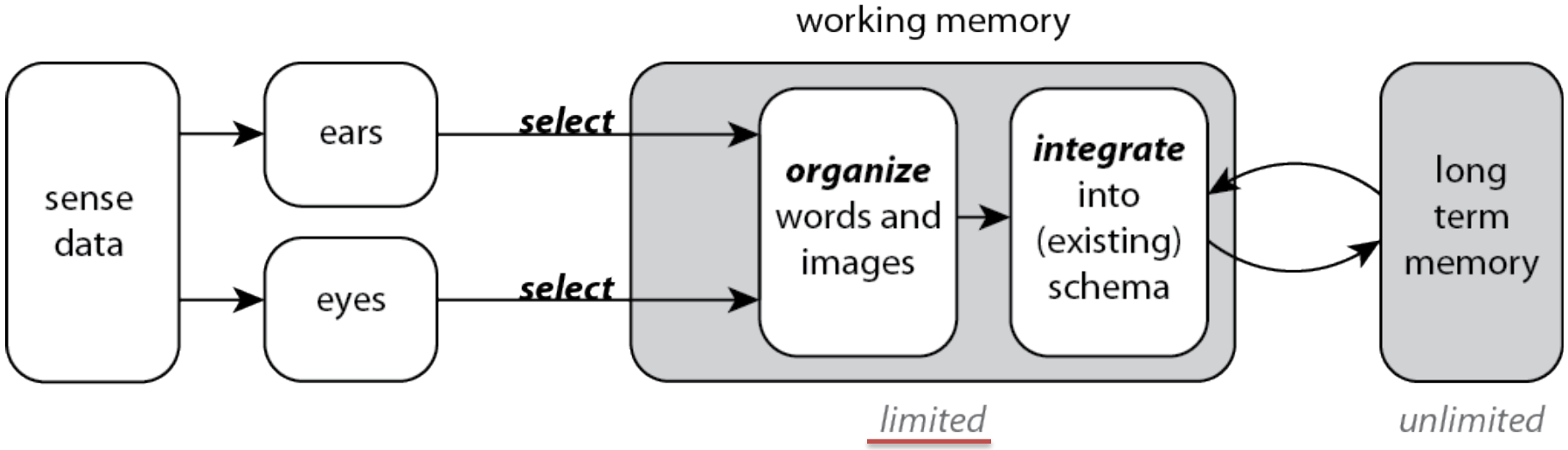
Sensorial overload

- Sensorial overload puts you in a flow state
- Literally too much to process at the same time
- Respond quickly to cues
- Cues can be made adaptive depending on whether someone is a ‘seven plus or minus two’ (Miller’s law)

Flow Paradox

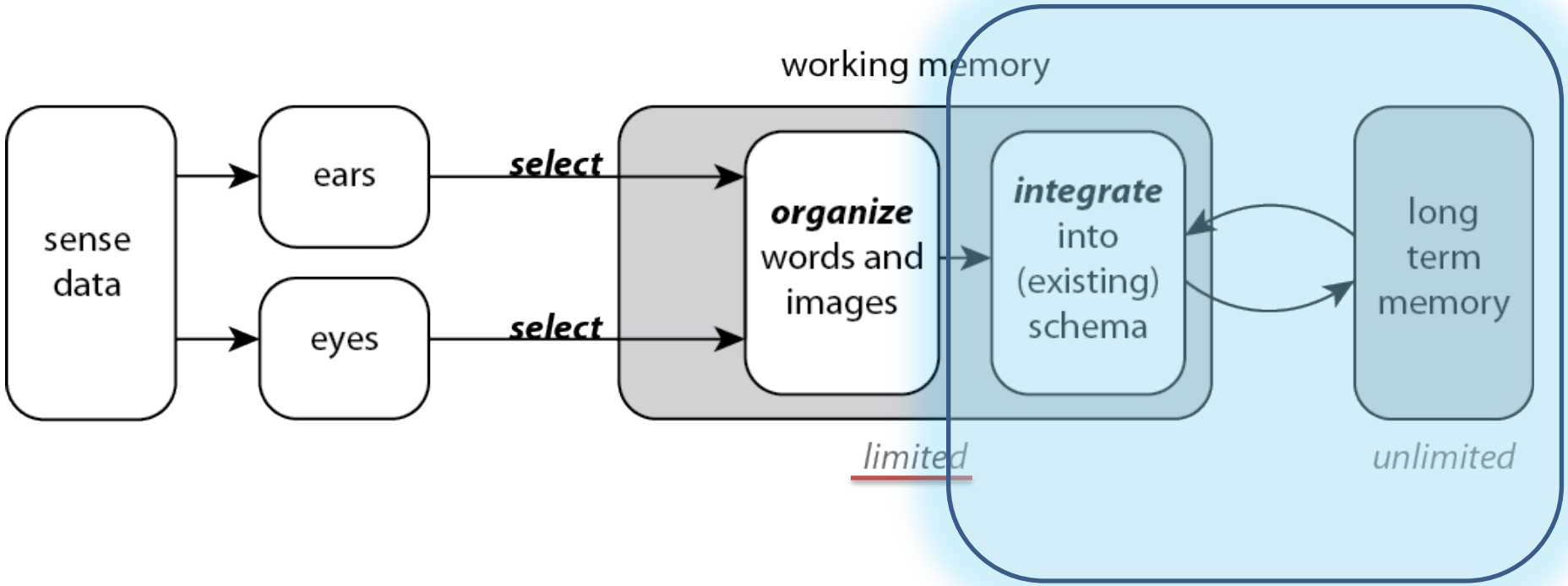
- But quick reactions lead to superficial learning; more reaction time training and automatization
- In fact, (adaptive) cueing is known to lead to less learning as well
- The more in Flow the less you learn

Mental model construction



- (Moreno & Mayer, 2003; Mayer, 2005)

Mental model construction



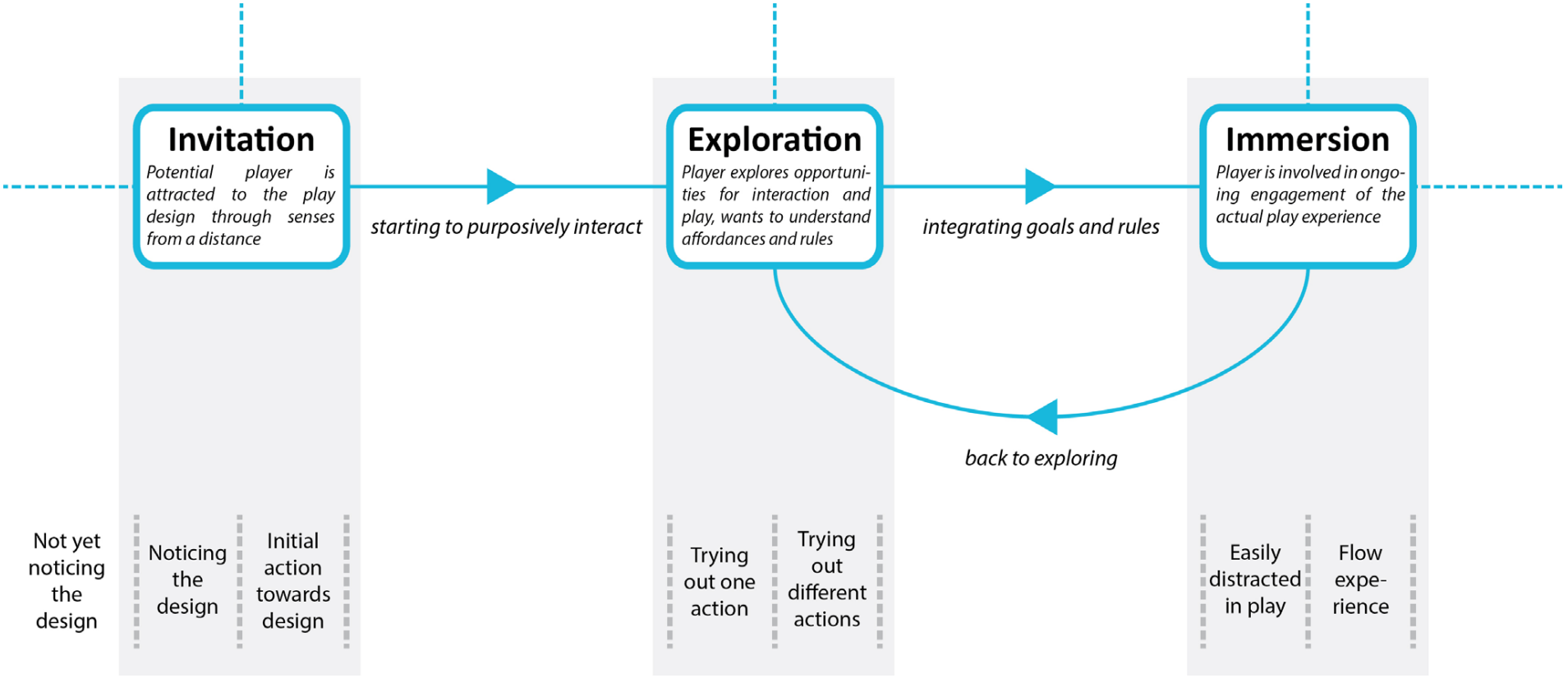
– **Deep learning / comprehension**

Improving knowledge integration

- **If you don’t want to adaptively create boring moments, but still want to create pockets of reflection and deep learning**

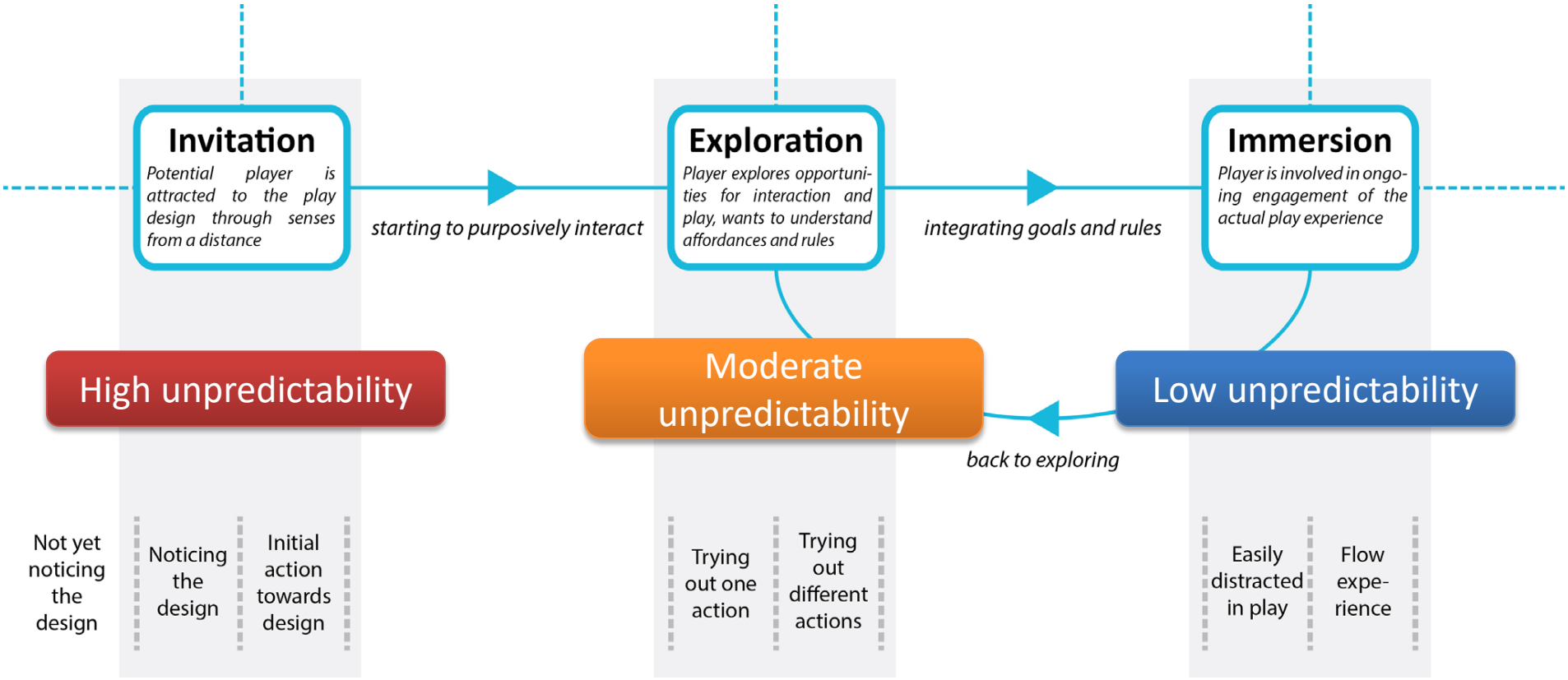
Blocking off existing pathways

Stages of play



de Valk, L., Bekker, T., & Eggen, B. (2015). Designing for social interaction in open-ended play environments. *International Journal of Design*, *9*(1), 107-120.

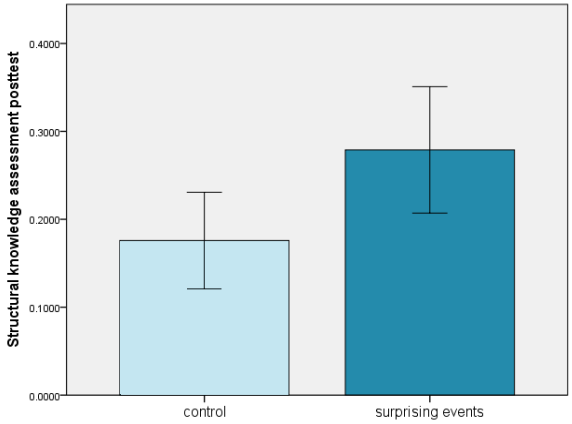
Predictability



de Valk, L., Bekker, T., & Eggen, B. (2015). Designing for social interaction in open-ended play environments. *International Journal of Design*, *9*(1), 107-120.

Surprising events

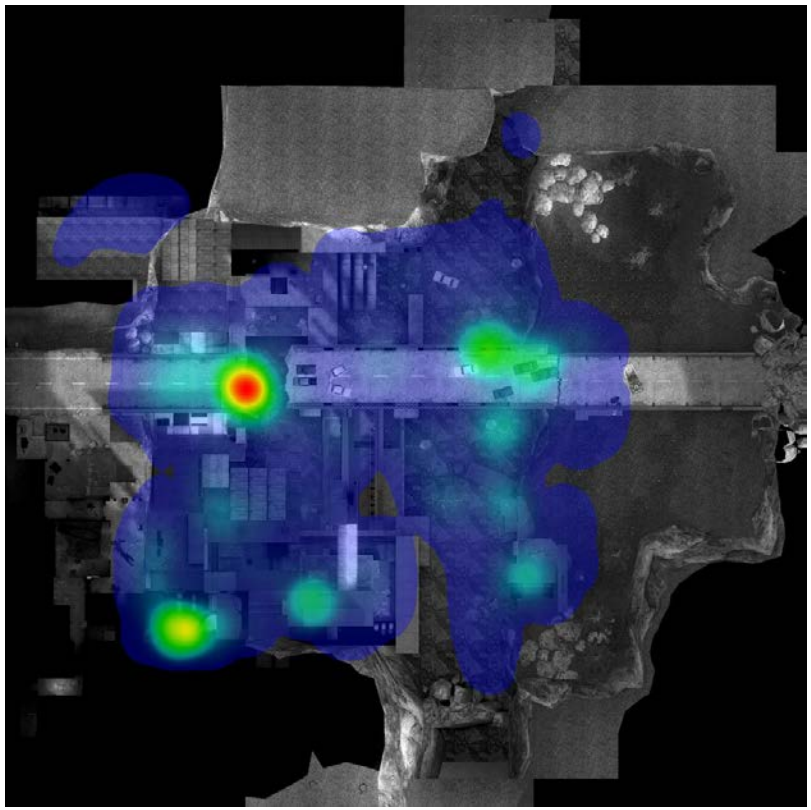
van der Spek, E. D., van Oostendorp, H., & Meyer, J. J. (2013). Introducing surprising events can stimulate deep learning in a serious game. *British journal of educational technology*, *44*(1), 156-169.



Introducing learning scaffolding

- **Measure performance:**
  - **High in-game score means understanding but can also be serendipitous**
  - **Consistently above a threshold and improving, probably means automatization**
  - **Consistently above a threshold but not improving, probably means complacency**

Offline adaptation



- **Can also simulate playthroughs**

Most of game analytics

- **Average F2P development team: 1 designer, 1 artist, 1 programmer, 6 business analysts tweaking the design to get more revenue**

Online overt assessment

- Biometrics
- Arousal recognition
- Emotion recognition

Biometrics

- **Brainball**

Air Medic Sky One

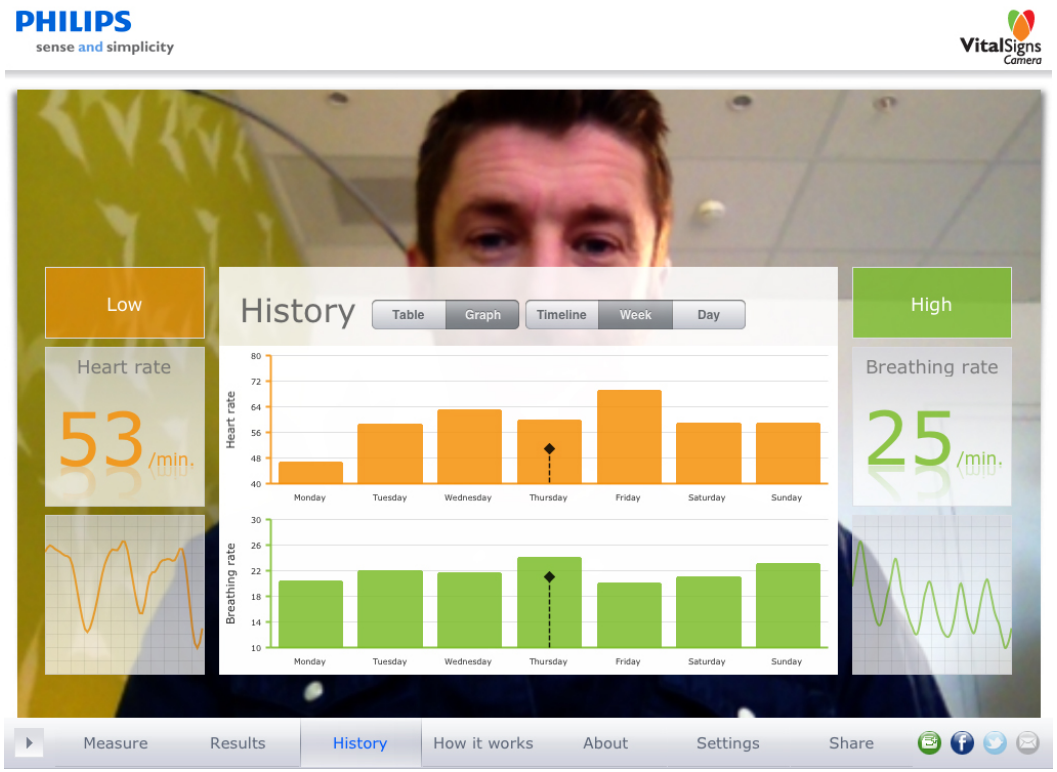
Arousal recognition

- Already seen stress cam, increase in stress = higher engagement, so good

- With a camera you can also measure

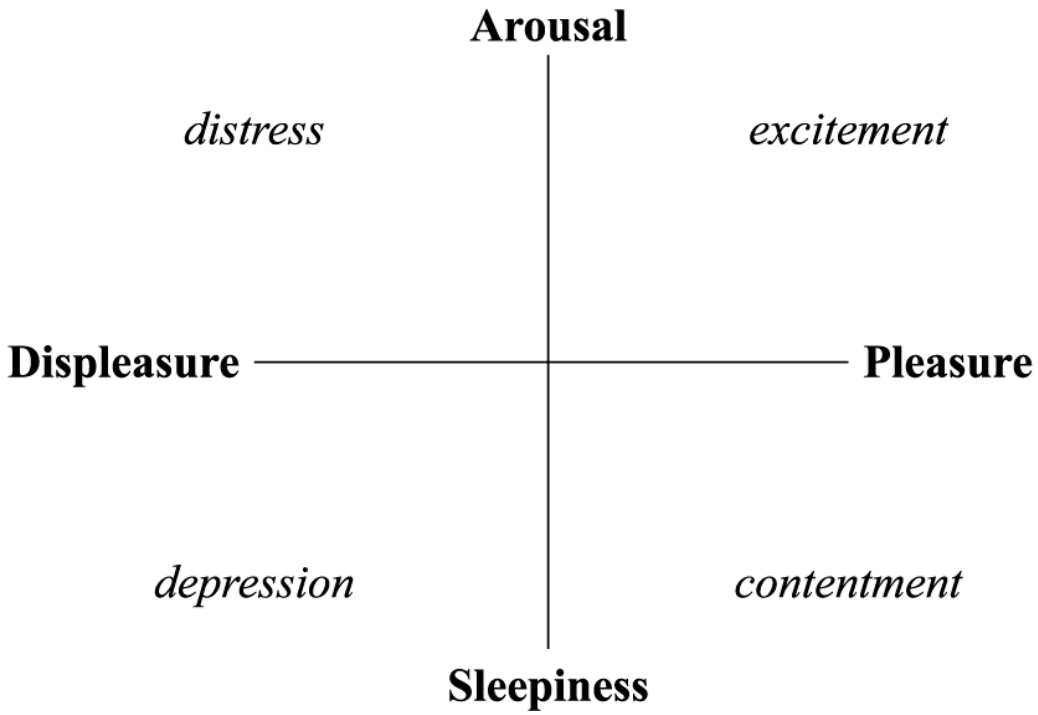
Camera

- Arousal, rapid breathing
- But is it stress (negative) or excitement (positive)?

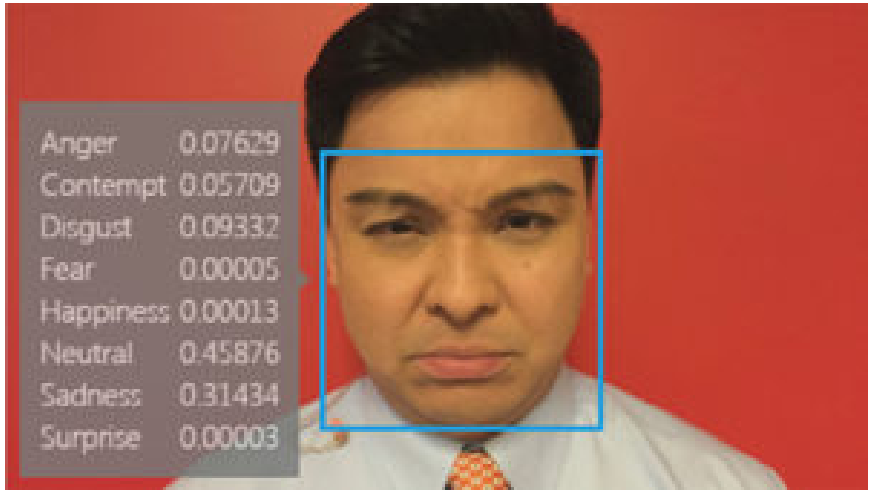


Circumplex model of affect

- **Only sensing arousal lacks valence measurement (pleasure-displeasure)**



Emotional recognition



- **But engaged people turn catatonic**

Back to motivation

- So how do you “know” when people are having fun?

Gamer motivation model

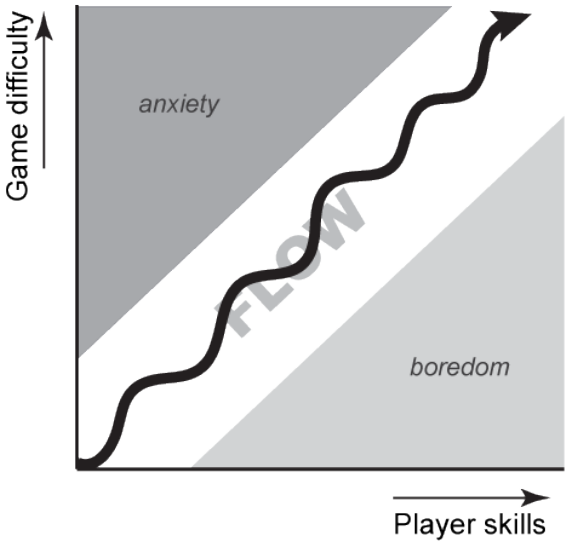
GAMER MOTIVATION MODEL

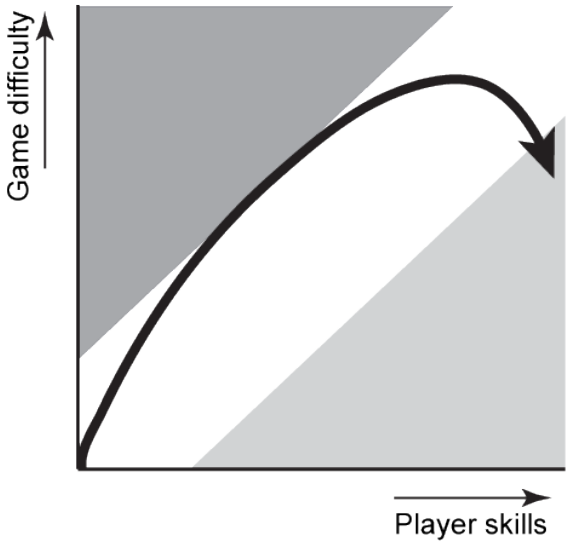
QUANTIC FOUNDRY

Action "Boom!"	Social "Let's Play Together"	Mastery "Let Me Think"	Achievement "I Want More"	Immersion "Once Upon a Time"	Creativity "What If?"
Destruction Guns. Explosives. Chaos. Mayhem.	Competition Duels. Matches. High on Ranking.	Challenge Practice. High Difficulty. Challenges.	Completion Get All Collectibles. Complete All Missions.	Fantasy Being someone else, somewhere else.	Design Expression. Customization.
Excitement Fast-Paced. Action. Surprises. Thrills.	Community Being on Team. Chatting. Interacting.	Strategy Thinking Ahead. Making Decisions.	Power Powerful Character. Powerful Equipment.	Story Elaborate plots. Interesting characters.	Discovery Explore. Tinker. Experiment.

- **Difficult to ascertain who belongs to what however**

Self-Determination Theory





- People are intrinsically motivated to satisfy three basic psychological needs:
- Competence, Autonomy, Relatedness

Self-Determination Theory

- **People have an innate psychological need for competence, autonomy, relatedness**

Self-Determination Theory

- **Player Experience of Needs Satisfaction:**

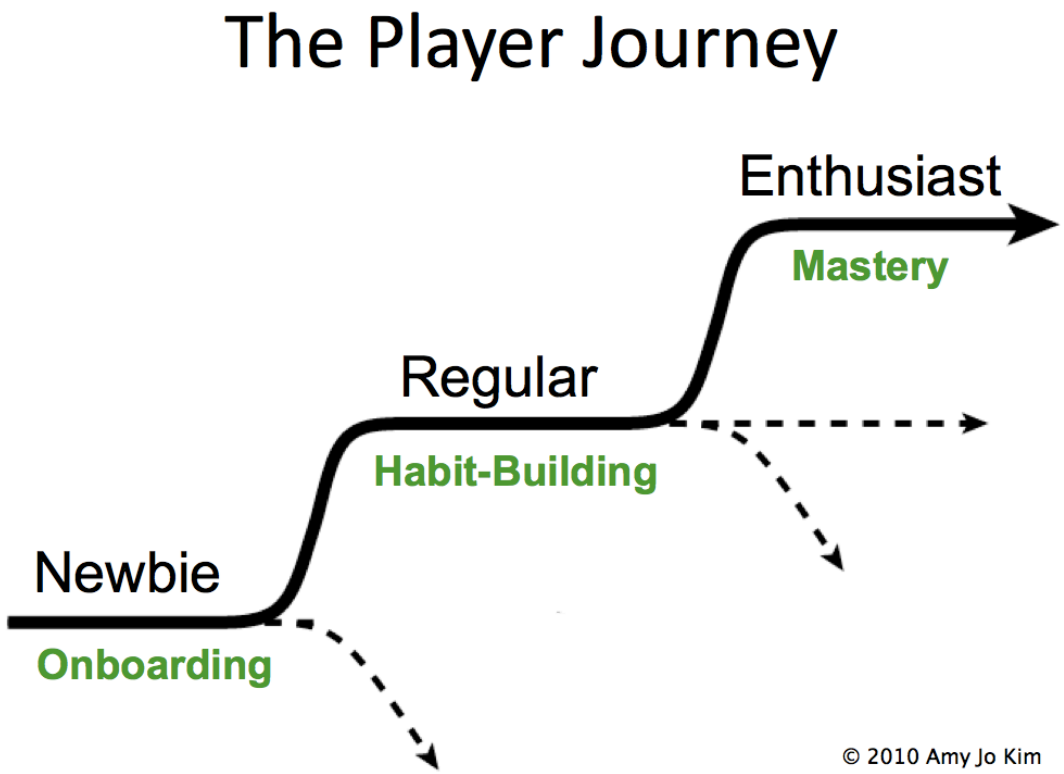
- ***Competence*: Easy to learn, difficult to master**
- ***Autonomy*: Choice, agency**
- ***Relatedness*: Interact, belong or care for others**

Adaptation

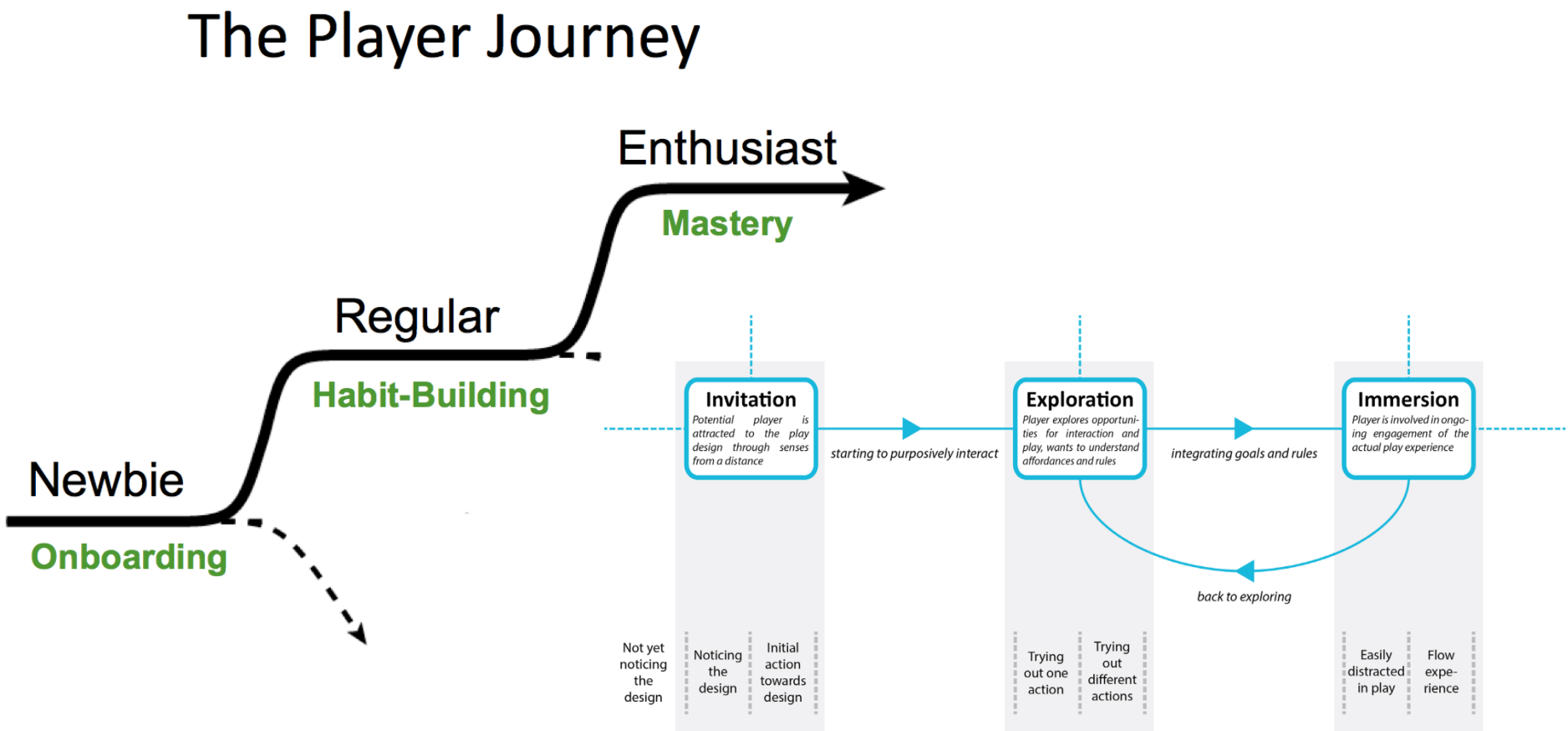
- **Whenever your feeling of competency is low**

- **Maybe don’t lower the bar, but stimulate autonomy/relatedness**

Player Journey



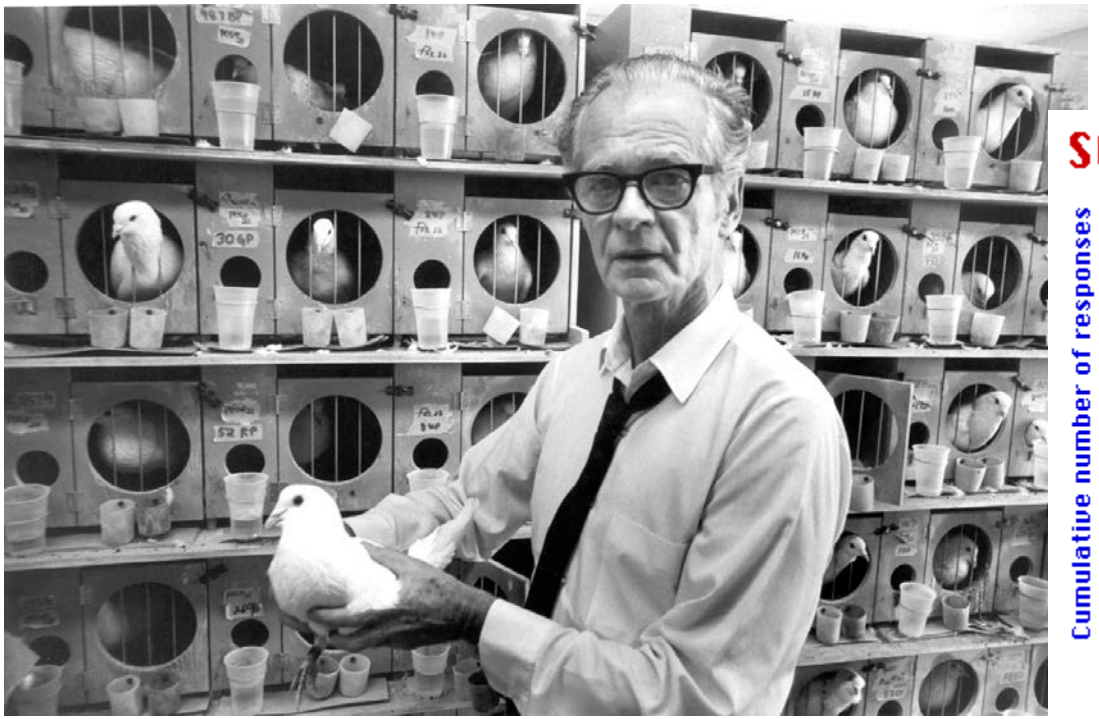
Player Journey

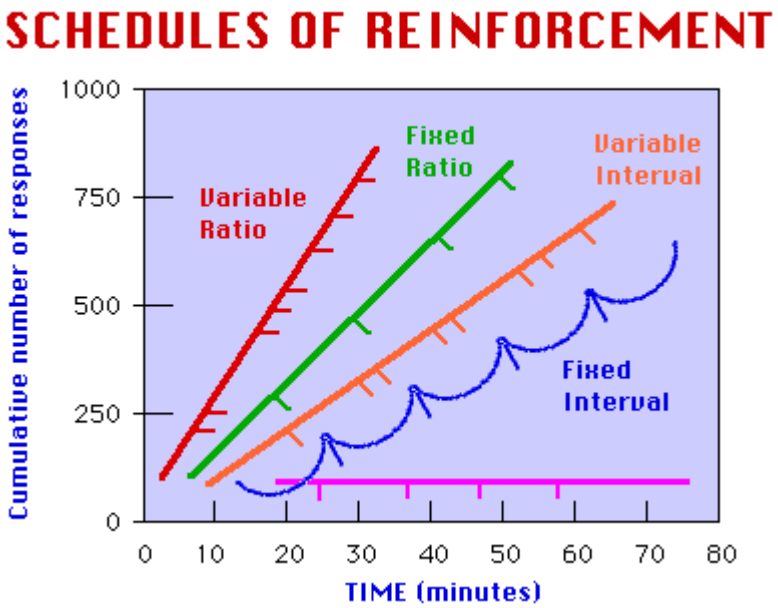


Gamification and application

- Whenever designers (or marketeers) want to use the ‘engaging power’ of games for their non-game products
- They usually add points, and awards and badges
- Don’t fall into this trap!

Operant conditioning





Skinner Boxing

- It works (in fact now many F2P games do it to shake you down)

- But are you having fun?
- Is it good design?

Reflection

- Try to make the activity itself fun
- Adapt on:
  - Predictability
  - Competence, autonomy, relatedness
  - Moments of dramatic action and downtime
- Using:
  - Online, offline, overt, covert assessment
- Keeping in mind:
  - Human cognitive system
  - Needs in player journey

Intelligent Playification