

# Interactive Storytelling:

*from procedural gameplay generation  
to brave new genres*

*Marc Cavazza*

*<http://ive.scm.tees.ac.uk/>*



Palombella Rossa (1989)  
Director: Nanni Moretti

# a Tale of Two Media

## Games are *Interactive*

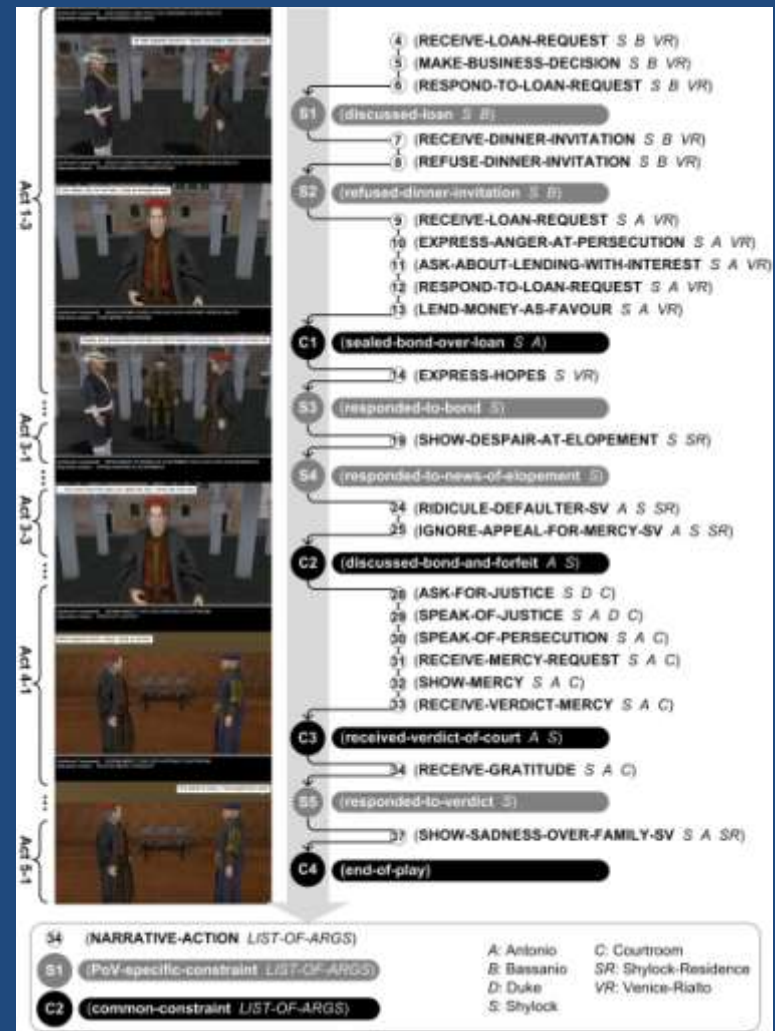
- Dynamic user-centric environment
- Games are striving to achieve a *filmic* experience
  - Cut-off scenes, improved visuals
  - characters' strong identity

## Films have High Aesthetic and Affective Content

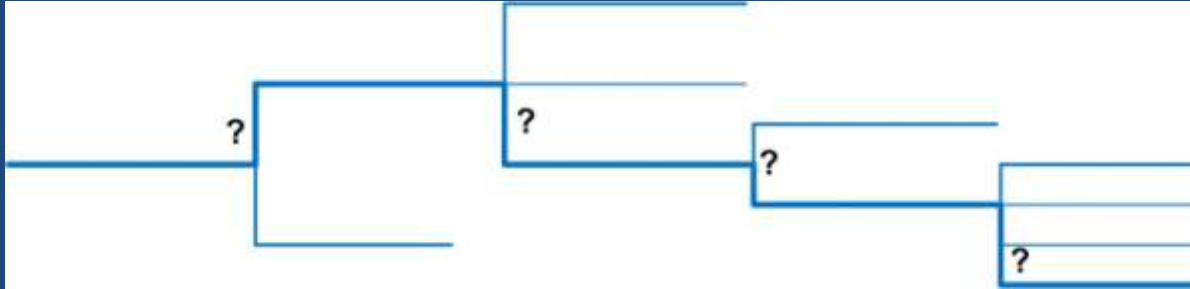
- Traditional Media (Film) have achieved recognition through their aesthetic qualities, all their production process is controlled (from scriptwriting to editing)
- No interactivity (content generation issue, narrative consistency issue)

# Key Idea #1: What's in a Story?

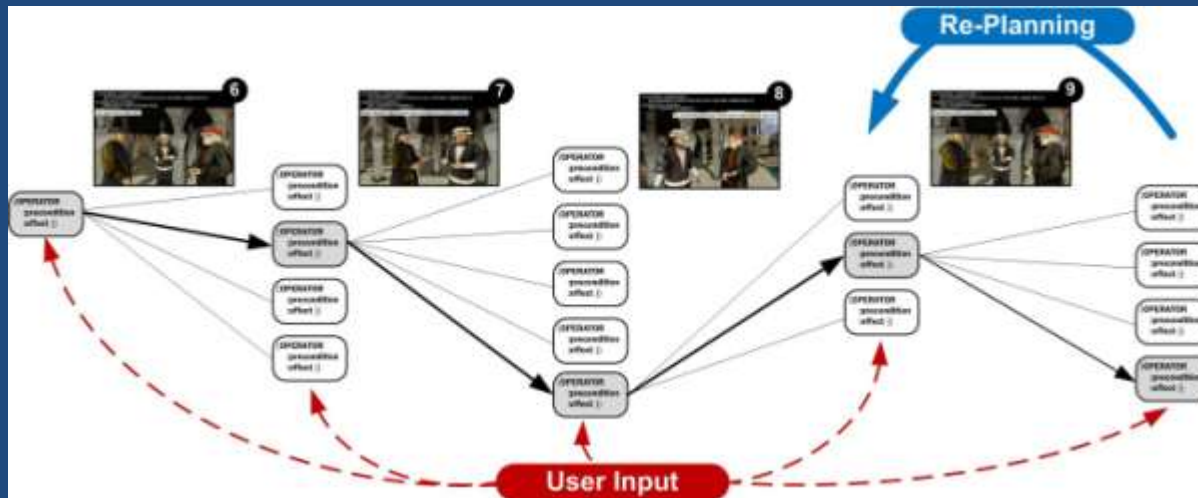
- A story can be described as a sequence of causally connected actions
- AI techniques such as *Planning* which generate action sequences towards a world state can be used to generate stories



# From “story” branching to Interactive Storytelling



- Fixed decision points
- Explicit graph
- Limited number of branches
- No “back-tracking”



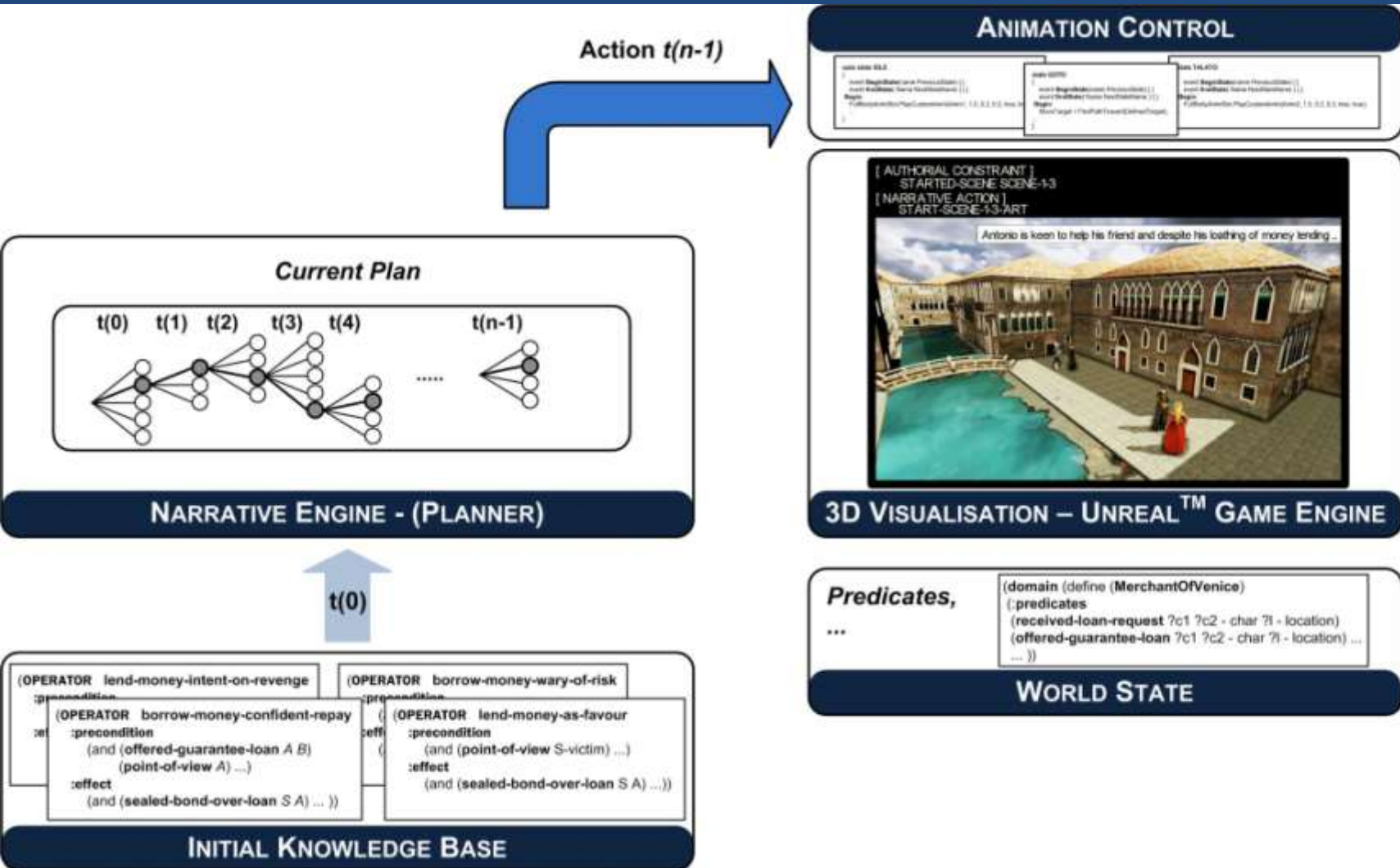
- Dynamically generated (implicit graph)
- Can generate many variants from the beginning
- Can accept input at each level
- Can regenerate dynamically

# IS *versus* standard Game AI

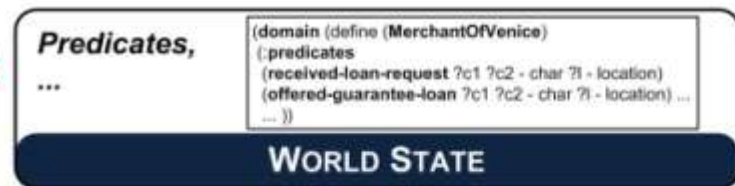
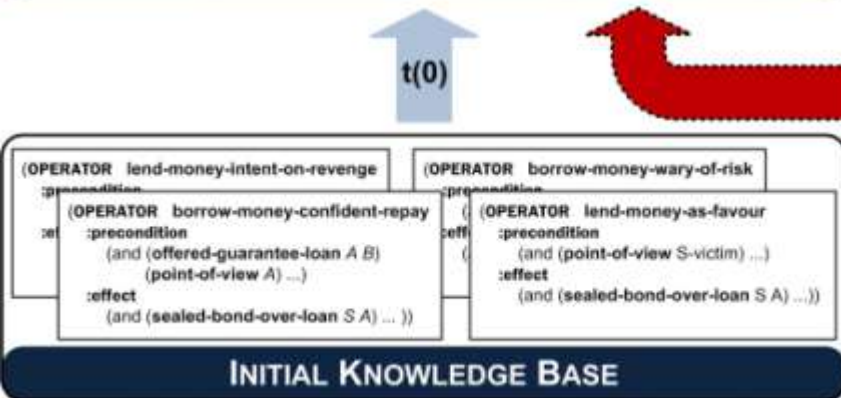
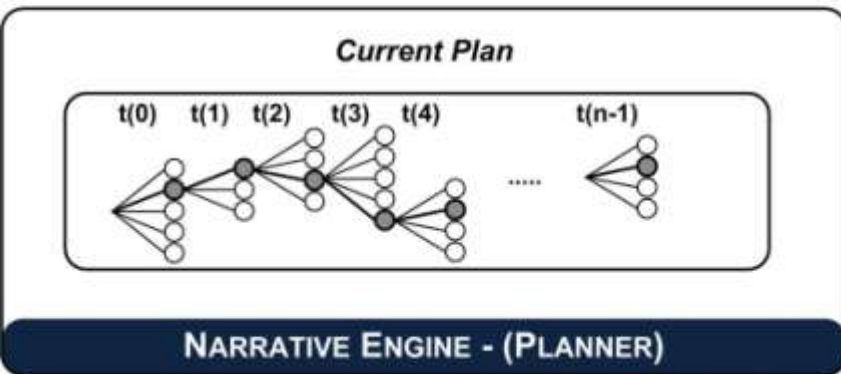
- Fine-grained planning of actions (each individual action)
- Characters follow a **global** story plan, or an individual plan (role) which covers the whole story
- Characters can re-plan (dynamic environment, user intervention ...)
- Coarse-grained planning of actions (levels, scenes)
- Characters are mostly reactive
- When/if characters have plans, these are **local**, task-specific and do not re-plan
- ⇒ IS cannot simply “emerge” from autonomous characters



# IS Generic Architecture



# IS Generic Architecture







# (Current) Gameplay Problems

- There is no real Interactive Storytelling genre in current gameplay philosophy because
  - Conflicts with the centrality of the player (who is *the* story's hero – if there is one)
  - Traditional gaming experience is conceived of as keeping the user interacting (few exceptions: simulation, God games ...)
- New 'filmic' game genres (e.g. Post-Sims <sup>TM</sup>)

# Three Case Studies

1. Blur the film / game distinction: *Machinima*-like approach
2. Use Interactive Storytelling techniques for Game Design instead of gameplay
3. Quantum Leap: explore future game genres: Immersive Interactive Storytelling

# 1. FILM-LIKE GAMING ENVIRONMENTS

# The Merchant of Venice

Wikimedia Commons

## The most excellent Historie of the *Merchant* of *Venice*.

With the extreame crueltie of *Sbylocke* the Iewe  
towards the sayd Merchant, in cutting a iust pound  
of his flesh: and the obtayning of *Portia*  
by the choyse of three  
chests.

*As it hath bene diuers times acted by the Lord  
Chamberlaine his Seruants.*

Written by William Shakespeare.



AT LONDON,  
Printed by *I. R.* for Thomas Heyes,  
and are to be sold in Paules Church-yard, at the  
signe of the Greene Dragon.  
1600.



Porteous, J., Cavazza, M., Charles, F. (2010). Narrative Generation through Characters' Point of View. In Proceedings of the 9th International Conference on Autonomous Agents and Multi-agent Systems (AAMAS 2010).



[ AUTHORIAL CONSTRAINT ]  
RESPONDED-TO-BOND SHYLOCK VENICE-RIALTO  
[ NARRATIVE ACTION ]  
EXPRESS-HOPES

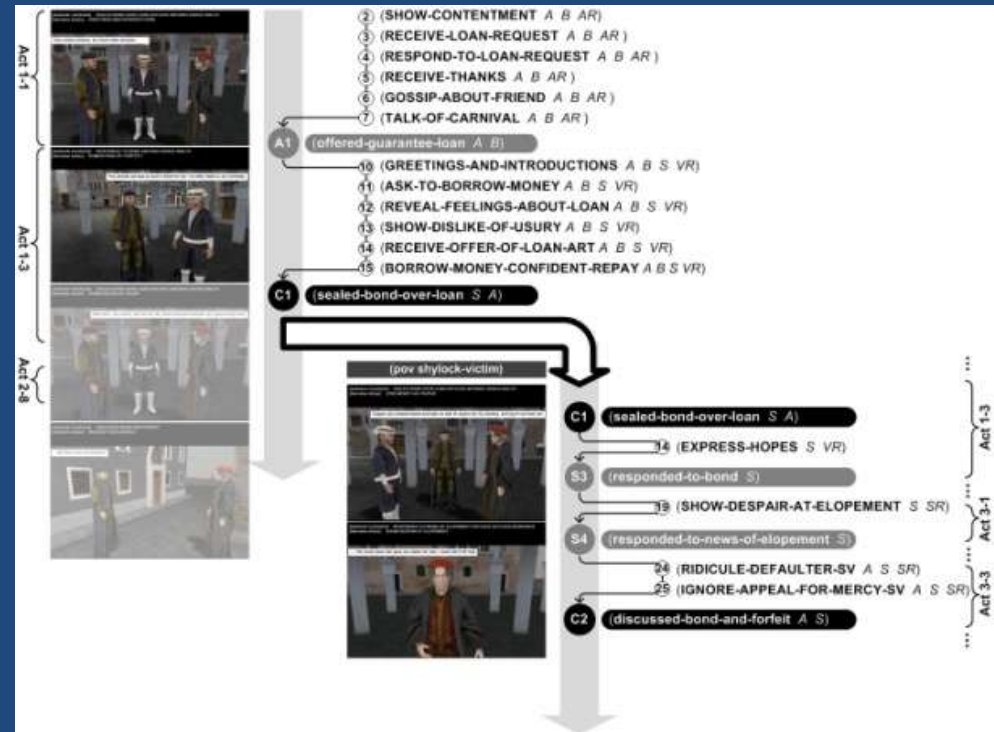
Tell me this: what should I gain by the exaction of the forfeiture?



```
[to-UDK](0): :action-id TA_SetCamera CAM_AntonioArrive  
[from-UDK]: :timestamp 258.9055 ActionStatusUpdate 1  
[to-UDK](1): :action-id TA_GoTo OBJ_ShylockLeave  
[from-UDK]: :timestamp 259.9763 ActionStatusUpdate 1  
[to-UDK](2): :action-id TA_SetCamera CAM_ShylockLeave  
[from-UDK]: :timestamp 260.0424 ActionStatusUpdate 1  
[to-UDK](3): :action-id TA_AnimSpeak sorry1  
[from-UDK]: :timestamp 261.1046 ActionStatusUpdate 1  
[to-UDK](4): :action-id TA_SpeakTo CHAR_SHYLOCK :speech EXPRESS-HOPES [Tell me this:  
[from-UDK]: :timestamp 261.1716 ActionStatusUpdate 1
```

# Key idea #2: Narrative Generation is the basis for Interactive Storytelling

- Narrative Generation is the process by which a consistent sequence of actions is produced from their logical description
- A new action sequence will be produced from a new world state



# Narrative Modelling

- We start by modelling the set of narrative actions as they happen in the ‘default’ story
- We then extend this description to incorporate *alternative* actions
  - that makes possible the generation of consistent variants
- (in *olde* terminology) “Authoring for Procedural Generation”, “Control by Design” ...

# IS Design Principle ...

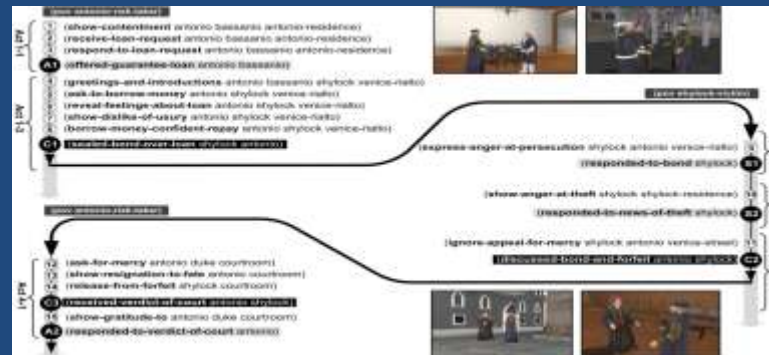
1. Model baseline story



2. Add new potential actions  
(NOT alternatives to specific  
baseline story actions)



3. Narrative Generation  
can now produce multiple  
variants





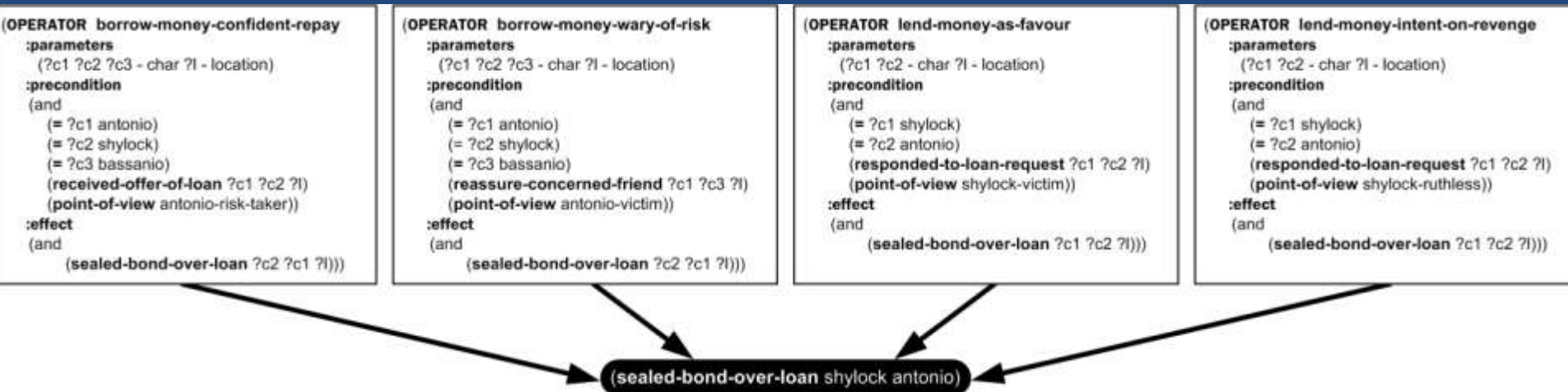
[ AUTHORIAL CONSTRAINT ]  
SEALED-BOND-OVER-LOAN SHYLOCK ANTONIO VENICE-RIALTO  
[ NARRATIVE ACTION ]  
ASK-TO-BORROW-MONEY2



```
[[from-UDK]: timestamp 30.7963 ActionStatusUpdate 1  
[[to-PLANNER]: a  
[[from-PLANNER]: ASK-TO-BORROW-MONEY2 ANTONIO SHYLOCK BASSANIO VENICE-RIALTO CST-SEALED-BOND-OVER-LOAN SHYLOCK ANTONIO VENICE-RIALTO  
[[to-UDK(0): :action-id TA_LocateAt OBJ_VeniceRialto2Right  
[[from-UDK]: timestamp 30.8720 ActionStatusUpdate 1  
[[to-UDK(1): :action-id TA_AnimSpeak sorry1  
[[from-UDK]: timestamp 30.8882 ActionStatusUpdate 1  
[[to-UDK(2): :action-id TA_SetCamera CAM_VeniceRialtoRight  
[[from-UDK]: timestamp 30.9190 ActionStatusUpdate 1
```



# Action Description



- Narrative Actions can be described as Planning operators, with their pre-conditions and effects
- *Variants* can be easily described for each action, which differ in means employed to achieve change, applicability conditions
- Example shown: different perspectives on a loan (risk-taking, hidden agenda ...)

[ AUTHORIAL CONSTRAINT ]  
SEALED-BOND-OVER-LOAN SHYLOCK ANTONIO VENICE-RIALTO

[ NARRATIVE ACTION ]  
ASK-TO-BORROW-MONEY1

```

[to-UDK]10: action-id TA_AvianSpeak sorry1
[from-UDK] timestamp 24.9240 ActorStatusUpdate 1
[to-UDK]11: action-id TA_SpeakTo CHAR_SHYLOCK
[from-UDK] timestamp 24.9407 ActorStatusUpdate 1
[to-UDK]12: action-id TA_ClearText CHAR_ANTONIO
[from-UDK] timestamp 30.4978 ActorStatusUpdate 1
[to-UDK]13: action-id TA_AvianIdle
[from-UDK] timestamp 30.5337 ActorStatusUpdate 1
[to-UDK]14: action-id TA_SetCamera CAM_VeniceRialtoRight
[from-UDK] timestamp 30.5488 ActorStatusUpdate 1

```

AV

[ AUTHORIAL CONSTRAINT ]  
SEALED-BOND-OVER-LOAN SHYLOCK ANTONIO VENICE-RIALTO

[ NARRATIVE ACTION ]  
RESPOND-TO-LOAN-REQUEST3

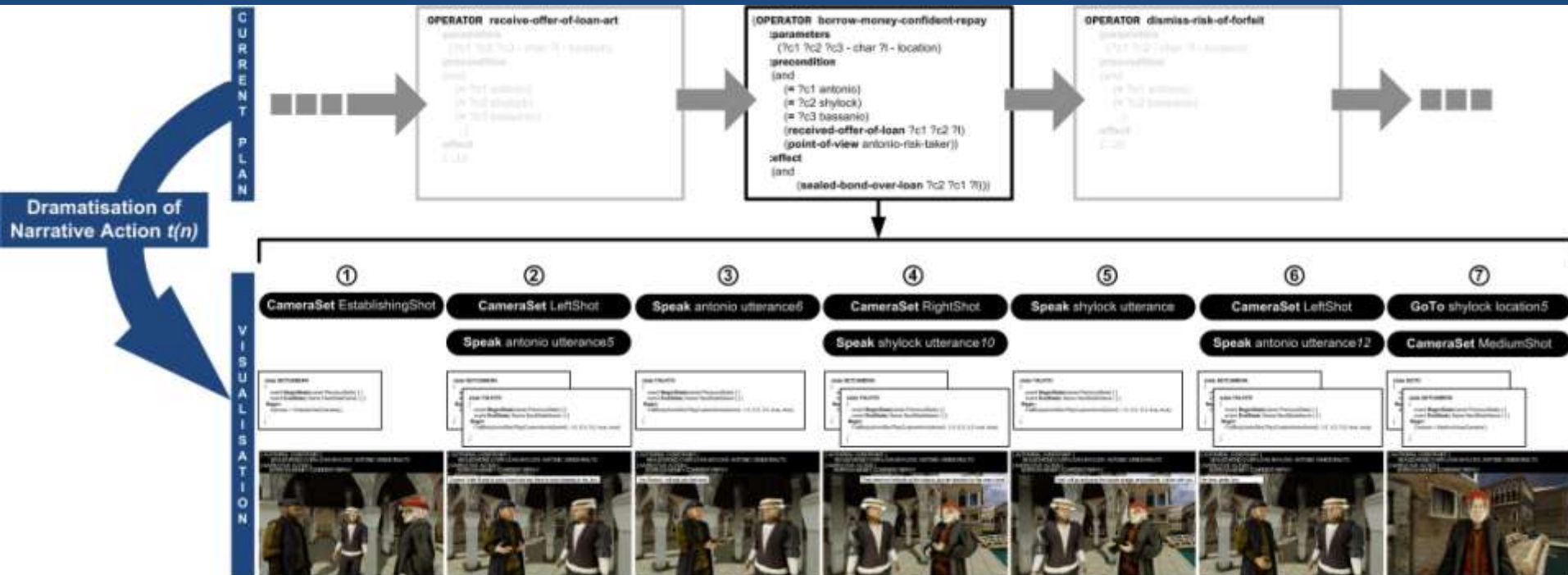
```

[to-UDK]20: action-id TA_AvianIdle
[from-UDK] timestamp 167.4900 ActorStatusUpdate 1
[to-UDK]21: action-id TA_ClearText CHAR_ANTONIO
[from-UDK] timestamp 167.5548 ActorStatusUpdate 1
[to-PLANNER] a
[from-PLANNER] RESPOND-TO-LOAN-REQUEST3 SHYLOCK ANTONIO VENICE-RIALTO_CST-SEALED-BOND-OVER-LOAN SHYLOCK ANTONIO VENICE-RIALTO
[to-UDK]0: action-id TA_LocateAt OBJ_VeniceRialtoRight
[from-UDK] timestamp 107.6580 ActorStatusUpdate 1
[to-UDK]1: action-id TA_SetCamera CAM_VeniceRialtoRight
[from-UDK] timestamp 167.7238 ActorStatusUpdate 1

```

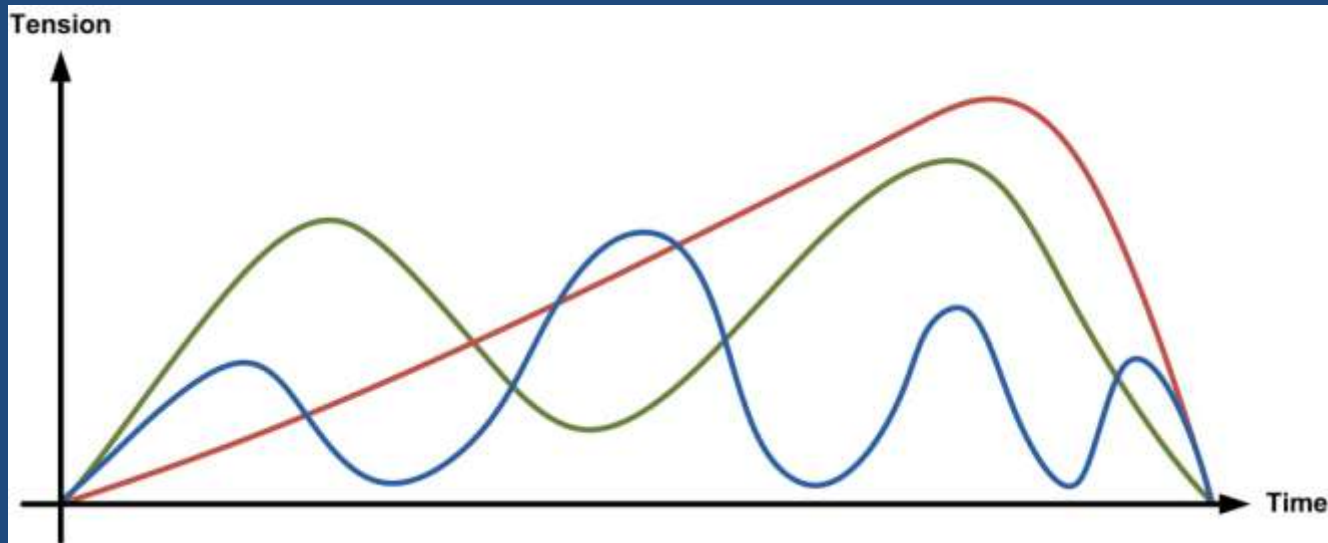
SV

# Mapping Narrative actions onto physical actions



- Narrative Generation operates at the level of generic actions
- These have to be instantiated as physical actions

# Key idea #3: Controlling Story Dynamics



- Narrative = actions + pace
- Generating a narrative means generating the sequence of actions that constitute its backbone
  - and this is why Planning is so popular as a technology, because it generates a sequence of actions progressing the world state towards a given state
- The next challenge is to control “pace”, the dynamics of actions ...



Joint work with Eidos Interactive

## **2. INTERACTIVE STORYTELLING TECHNIQUES FOR GAME DESIGN**



# The Problem

- Exploring Interactive Storytelling for current game genres
- Hitman <sup>TM</sup> : has narrative aspects, and Hitman <sup>TM</sup> has to elaborate various *plans* to achieve its mission objectives
- However: Hitman <sup>TM</sup> is the player character, there would be *no gameplay* if solutions were automatic!

# Storyboarding ...



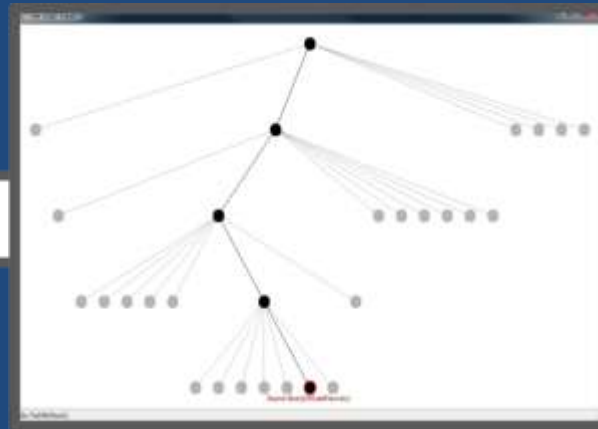
Original design documents courtesy of  
Eidos and IO Interactive

# Generation of Game Level Solutions

## Domain Implementation

## Solution Generation

## Storyboards Generation



**Actions:**

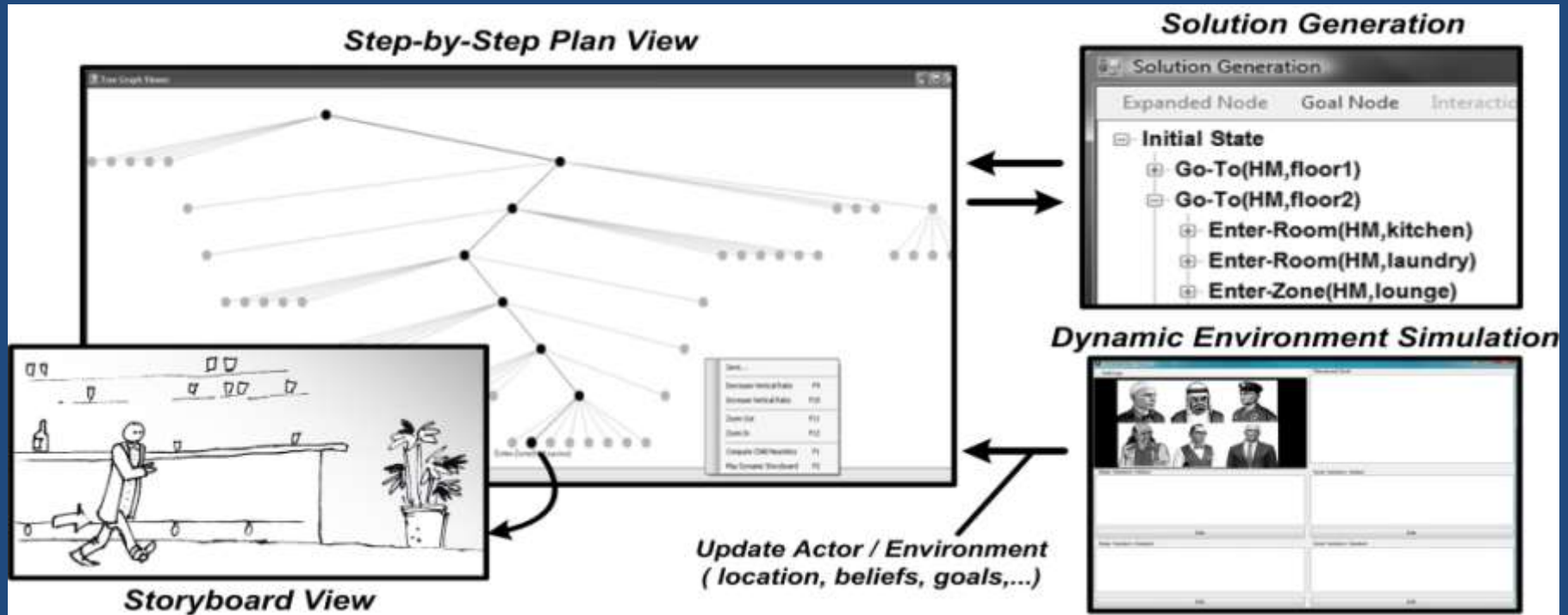
Strips operator

**HSP:**

Heuristic Search Planning



# Plan-based Solution Generation

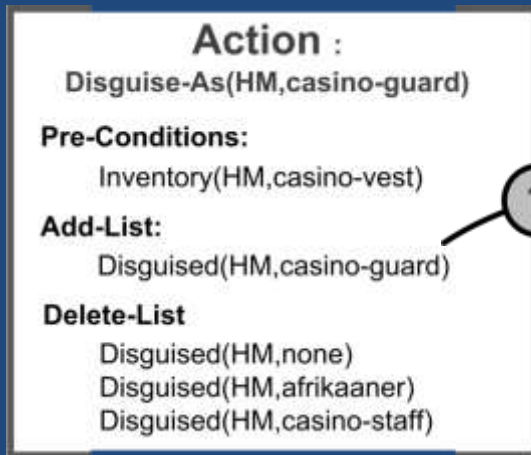


Pizzi, D., Lugin, J.-L., Whittaker, A. And Cavazza, M. Automatic Generation of Game Level Solutions as Storyboards. *IEEE Transactions on Computational Intelligence and Artificial Intelligence in Games*, in press

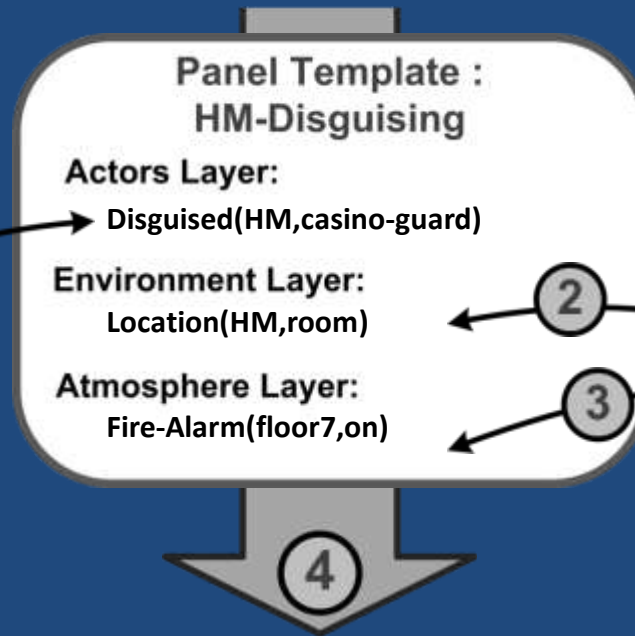
# Storyboard Generation

## Heuristic Search Planner

*Selection of Action*



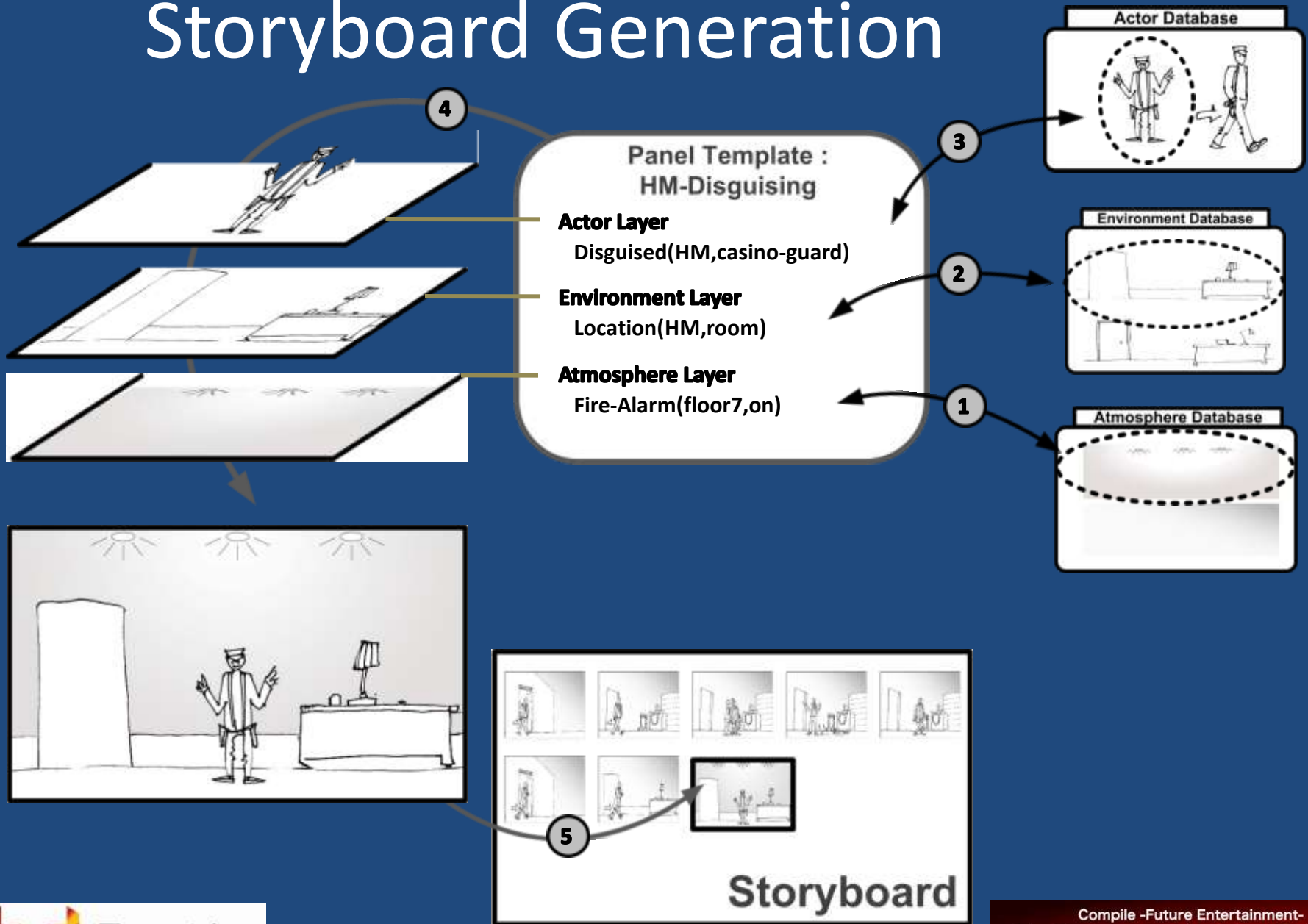
*Panel Template Instantiation*



*Panel Template Generation*



# Storyboard Generation

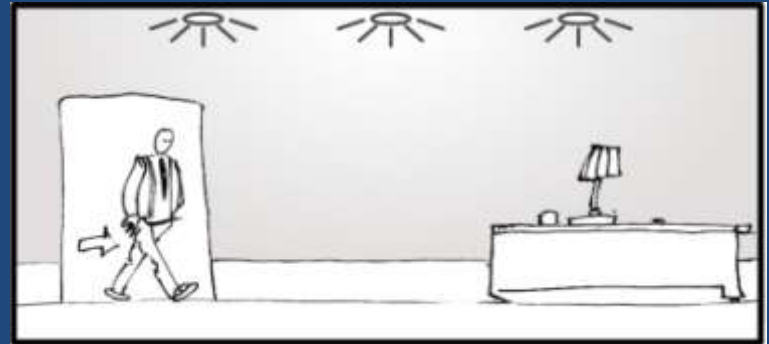


# Situation Example

...



*Trigger-Fire-Alarm(HM,floor7)*



*Go-To(HM,room)*



*Shoot(HM,casino-guard)*

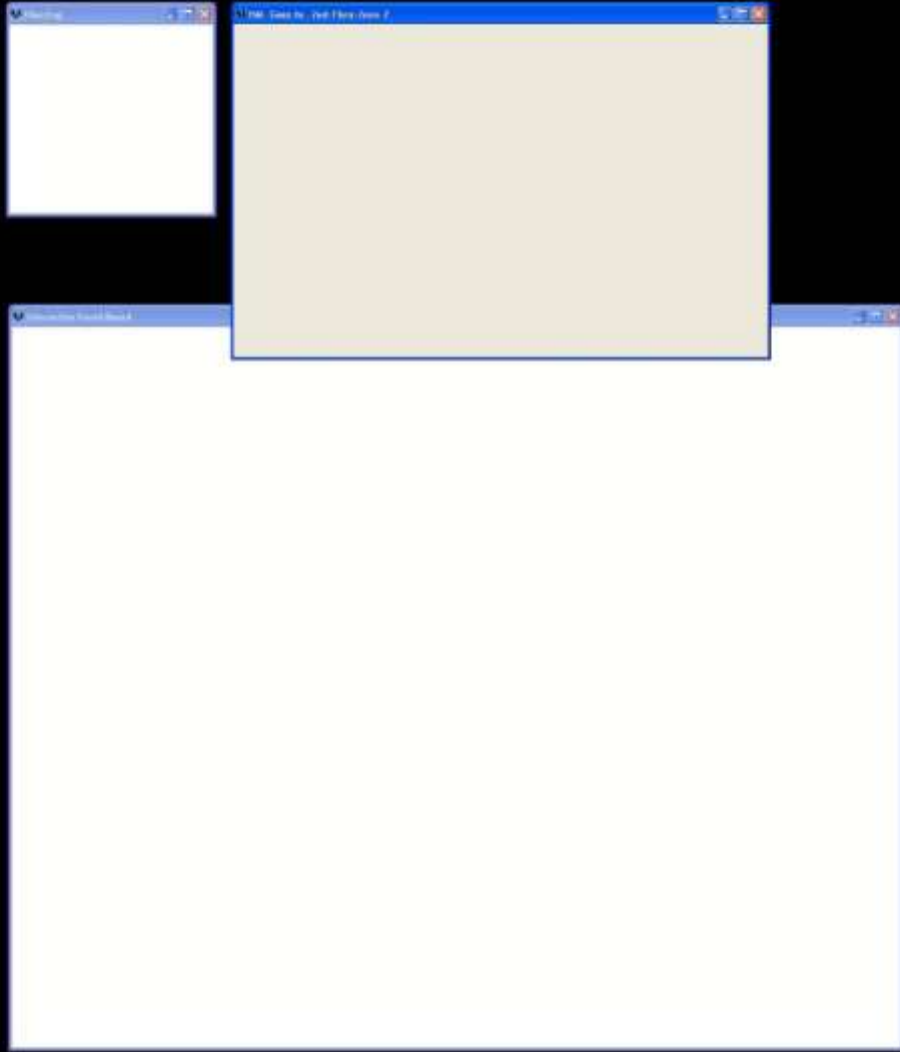


*Search-Body(HM,casino-guard)*

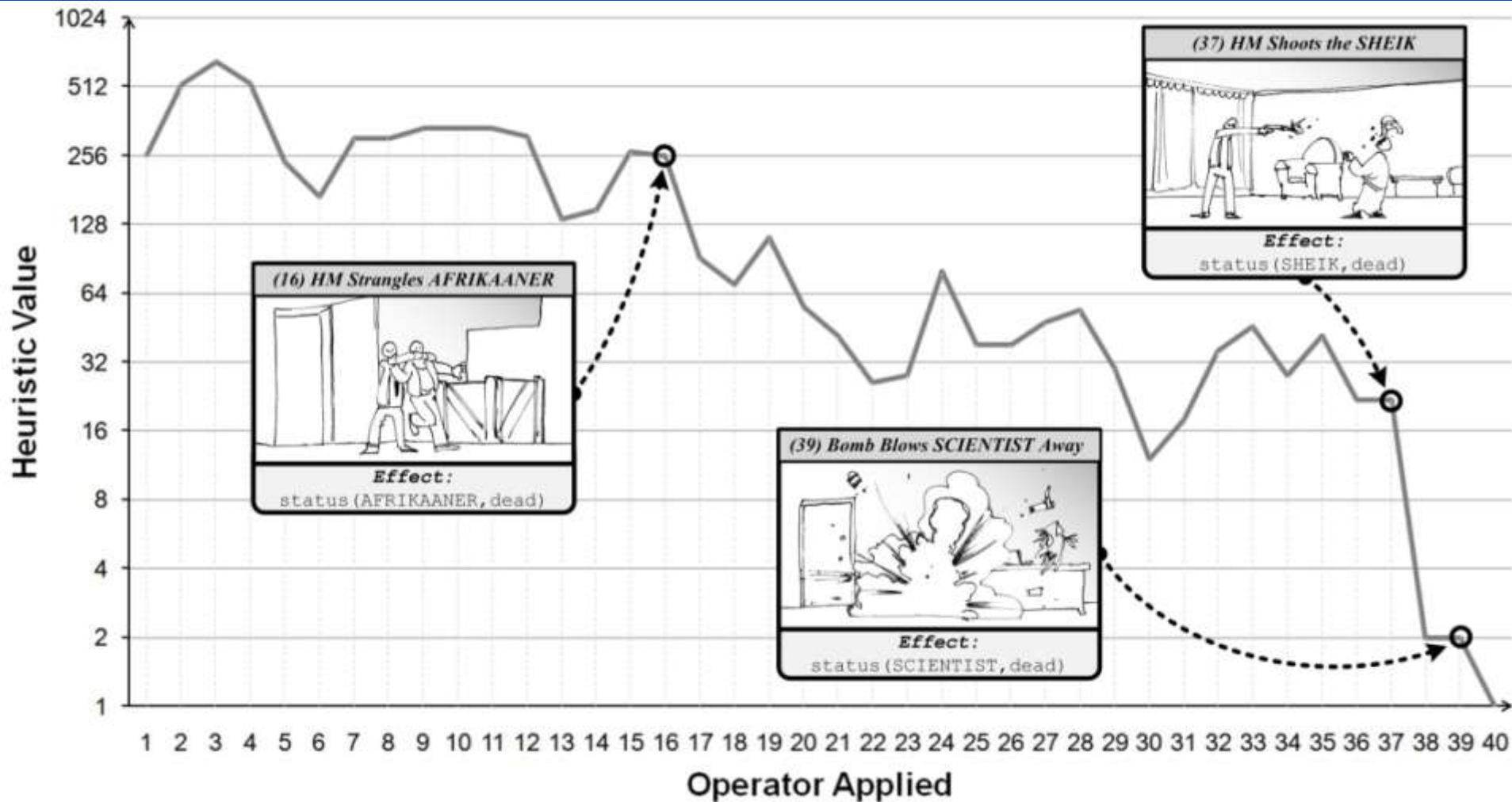


*Disguise-As(HM,casino-guard)*

**etc.**



# Plan Progression: *visualising* gameplay?



# Lessons Learned

- If the system uncovered new possible level solutions ...
- ... this means that in current game design not all solutions are visible / controllable from a design perspective
- So, why be afraid of Narrative Generation?

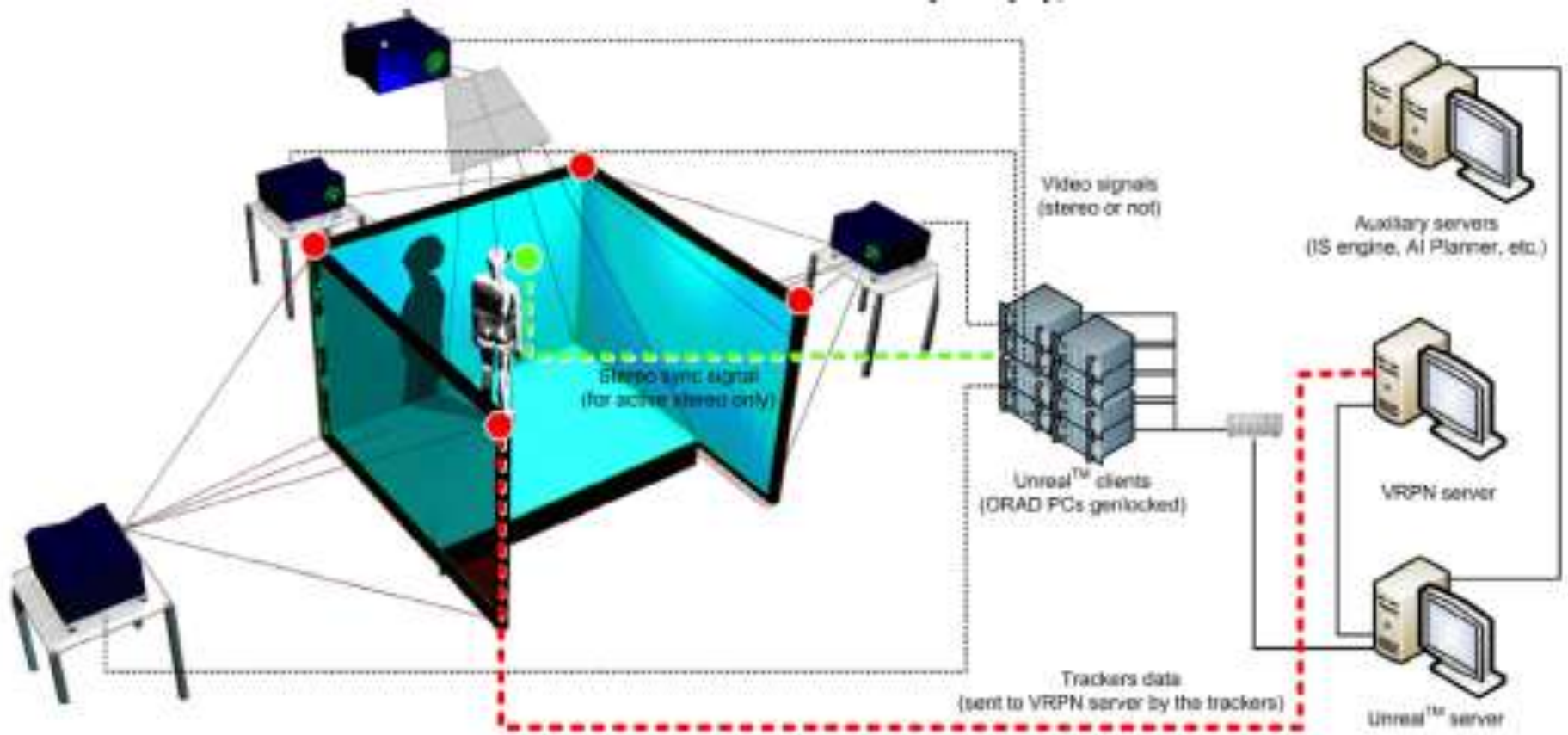


# 3. IMMERSIVE INTERACTIVE STORYTELLING

# Holodeck™ -like Systems



# CaveUT™ Architecture



*Unreal Tournament* is a Trademark of Epic Games

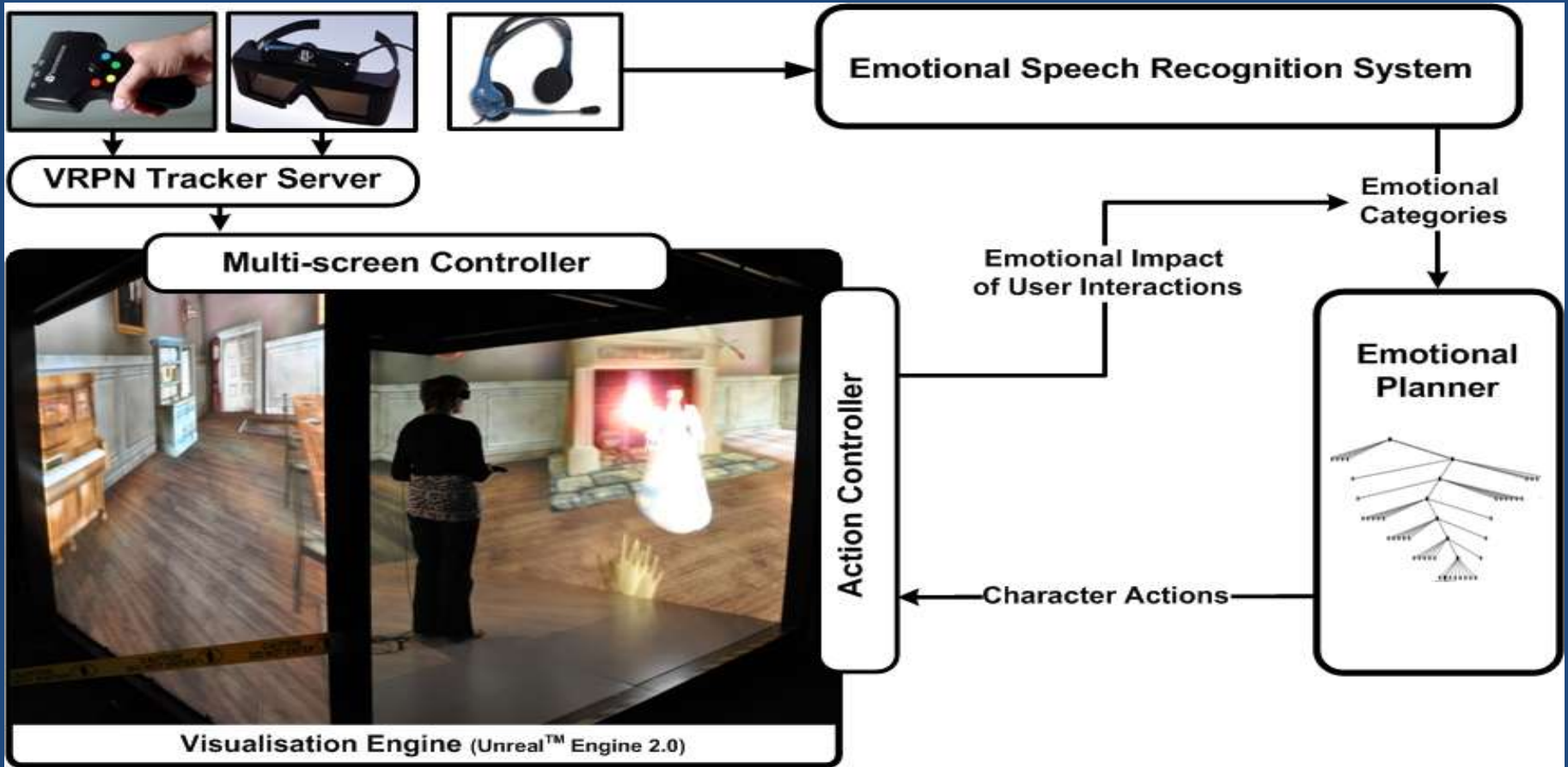
CaveUT is a Trademark of PublicVR

CAVE is a Trademark of the University of Illinois at Chicago

# CaveUT™

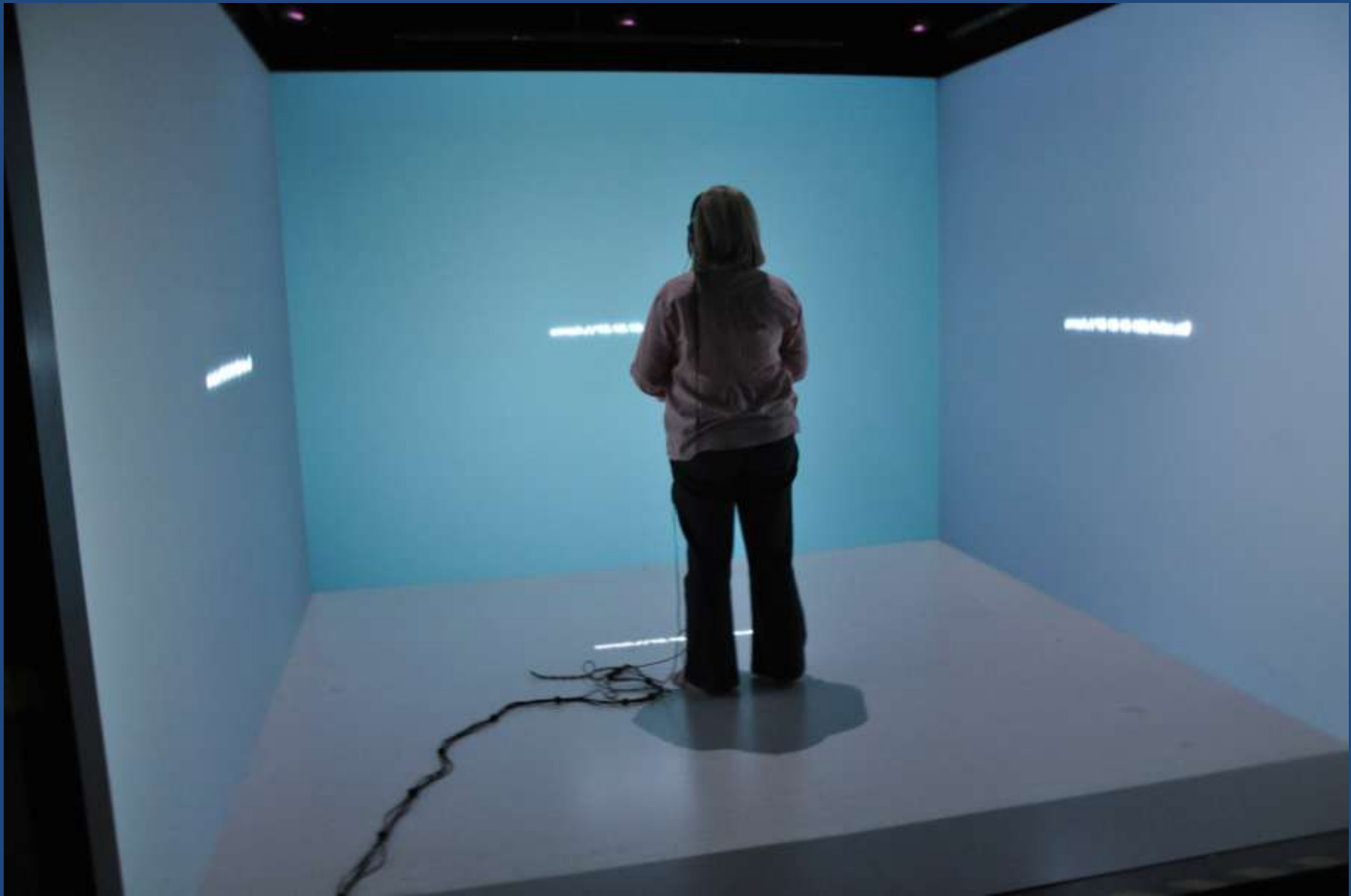
- Unreal Engine ported to multi-screen display with real-time head tracking and wand controller
- Developed by PublicVR ([www.publicVR.org](http://www.publicVR.org))
- Stereoscopic extension by Teesside University
- Real-time, immersive, stereoscopic visualisation and interaction based on the Unreal Engine

# Immersive Interactive Storytelling



Lugrin, J.-L., Cavazza, M., Pizzi, D., Vogt, T., and Andre E., 2010  
Exploring the Usability of Immersive Interactive Storytelling  
ACM Virtual Reality and Software Technology 2010,  
Hong-Kong, to appear









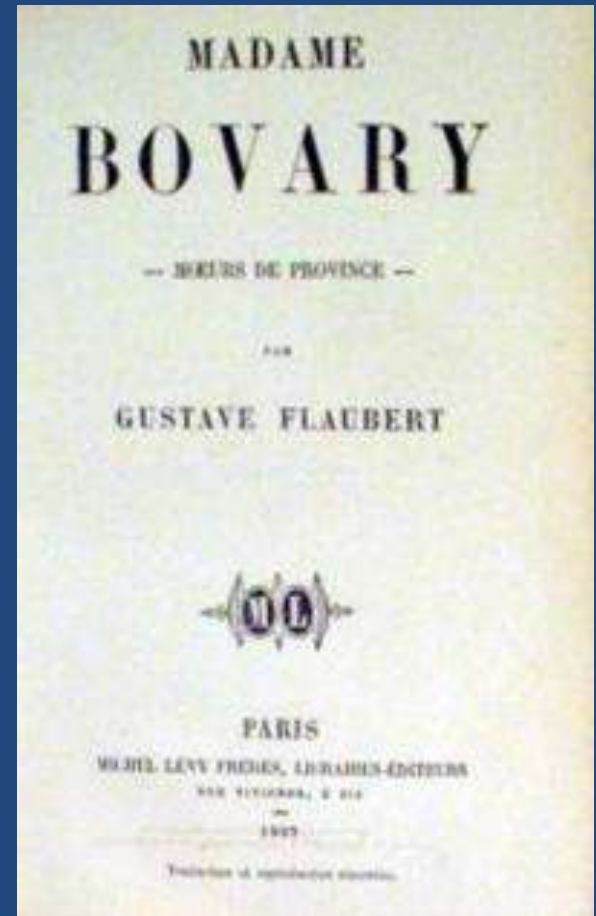
Interacting with objects

Interacting with Characters





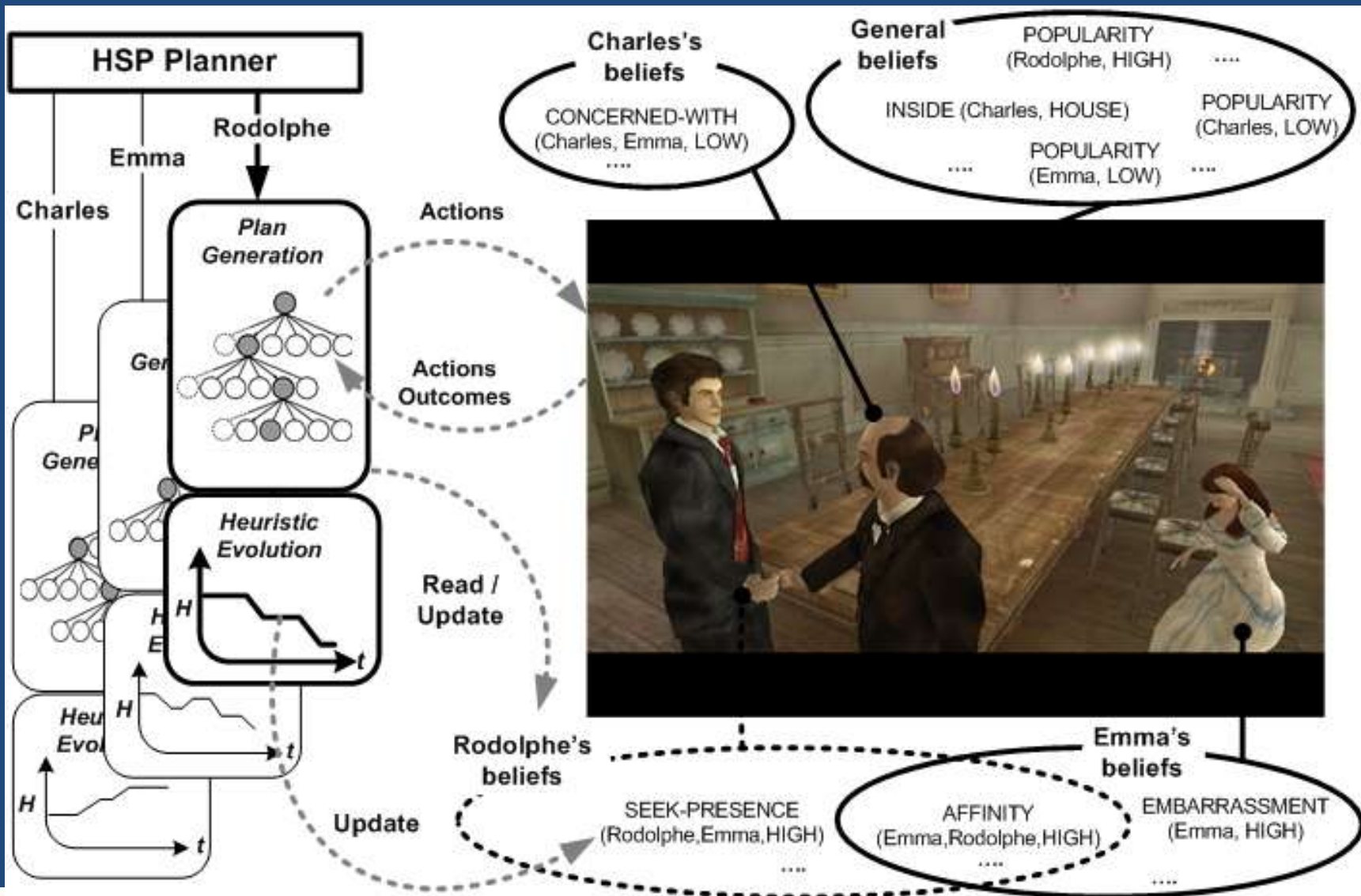
# The Narrative: *Madame Bovary*



Wikimedia Commons

Marc Cavazza, Jean-Luc Lugin, David Pizzi, Fred Charles:  
Madame Bovary on the Holodeck: immersive interactive storytelling.  
ACM Multimedia 2007, pp. 651-660.

# Interactive Madame Bovary





## Emma-Kissing -Rodolphe

Type: Action

### Conditions:

#### Exe-Cond:

Inside (E,HOUSE)  
Inside (R,HOUSE)  
Not Inside (C,HOUSE)

#### Pre-Cond:

Adultery-Accepted-Risk (E, C, HIGH)  
Affinity (E,R, MEDIUM)

### Effects:

#### Add-List:

Affinity (E,R,HIGH)  
Excitement (E, HIGH)  
Womanhood (E, HIGH)  
Seek-Presence-of (E, R, HIGH)

#### Delete-List:

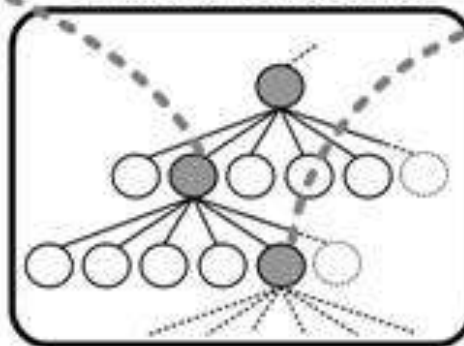
Affinity (E, R, MEDIUM)  
Womanhood (E, LOW)  
Womanhood (E, MEDIUM)  
Seek-Presence-of (E, R, LOW)  
Seek-Presence-of (E, R, MEDIUM)  
Excitement (E, LOW)  
Excitement (E, MEDIUM)

Add-Goal: nil

Del-Goal: nil

## Emma Plan Generation

1



3

## Emma-In-Love-Attitude

Type: Interpretation

### Conditions:

#### Exe-Cond:

Inside (E,HOUSE)

#### Pre-Cond:

Excitement (E, HIGH)  
Affinity (E, R, HIGH)

### Effects:

#### Add-List:

Affinity (E, L, LOW)  
Adultery-Accepted-Risk(E, C, HIGH)  
Pride (E, HIGH)

#### Del-List:

Affinity (E,L, MEDIUM)  
Affinity (E,L, HIGH)  
Adultery-Accepted-Risk (E, C, LOW)  
Adultery-Accepted-Risk (E, C, MEDIUM)  
Pride (E, LOW)  
Pride (E, MEDIUM)

#### Add-Goal:

Satisfaction (E, HIGH)

Del-Goal: nil



2

E = Emma | C= Charles (Emma's husband) | L= Leon (Emma's ex-lover) | R =Rodolphe (Emma's new lover)

## Baseline Story

COMPLAINS-ABOUT-CHARLES  
**INCREASES-ADULTERY-RISKS-TAKING**  
 GIVES-FRIENDLY-WAVES-TO-RODOLPHE  
 ACCEPTS-CONVERSATION-RODOLPHE  
**DISAPPOINTED-IN-CHARLES**  
 SAYS-STHG-IN-CONFIDENCE-RODOLPHE  
**FEELS-HATRED-TOWARD-CHARLES**  
 ACCEPTS-RODOLPHE-OUT  
 MAKES-LOVE-DECLARATION-TO-RODOLPHE  
 KISSED-BY-RODOLPHE  
 PHYSICAL-CONTACT-WITH-RODOLPHE  
**IN-LOVE-ATTITUDE**  
**EMBOLDENED-BY-LOVE**  
 ANXIOUS-OF-LOOSING-RODOLPHE  
 OFFERS-GIFTS-TO-RODOLPHE  
 JOY-OF-LOVE



## Interaction

LOSS-OF-INTEREST-IN-MOTHERHOOD  
**INCREASES-ADULTERY-RISKS-TAKING**  
 GIVES-FRIENDLY-WAVES-TO-RODOLPHE  
 ACCEPTS-CONVERSATION-RODOLPHE  
**FEELS-HATRED-TOWARD-CHARLES**  
 SAYS-STHG-IN-CONFIDENCE-RODOLPHE  
 ACCEPTS-RODOLPHE-OUT  
 KISSED-BY-RODOLPHE  
 PHYSICAL-CONTACT-WITH-RODOLPHE  
 MAKES-LOVE-DECLARATION-TO-RODOLPHE  
**IN-LOVE-ATTITUDE**  
**EMBOLDENED-BY-LOVE**  
 SELF-CONTROL  
 COMMISERATION  
 REGRETS-FALLING-FOR-RODOLPHE  
 EMPHASISES-MOTHERHOOD



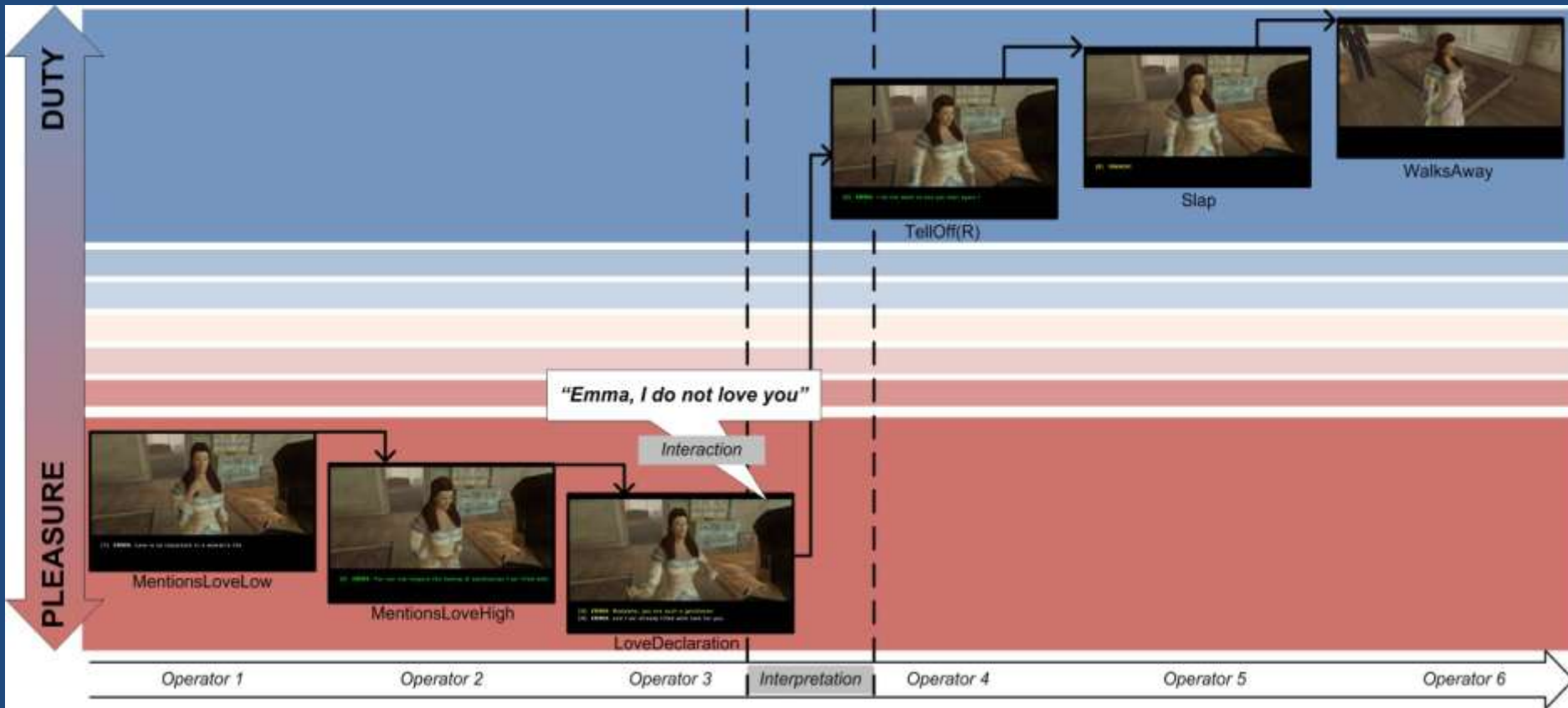
Action Operator  
 Interpretation Operator

○ — New Local Goal

→ — Local Goal Reached and Deleted

□ — Belief Modified

# EmoEmma



Cavazza, M., Pizzi, D., Charles, F., Vogt, T. and André, E., 2009. Emotional Input for Character-based Interactive Storytelling. In: *Proceedings of the 8th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, Budapest, Hungary, May 2009, pp. 313-320.



# User Interaction Paradigms

Actor mode:  
plays as *Rodolphe*



Ghost mode: free ride





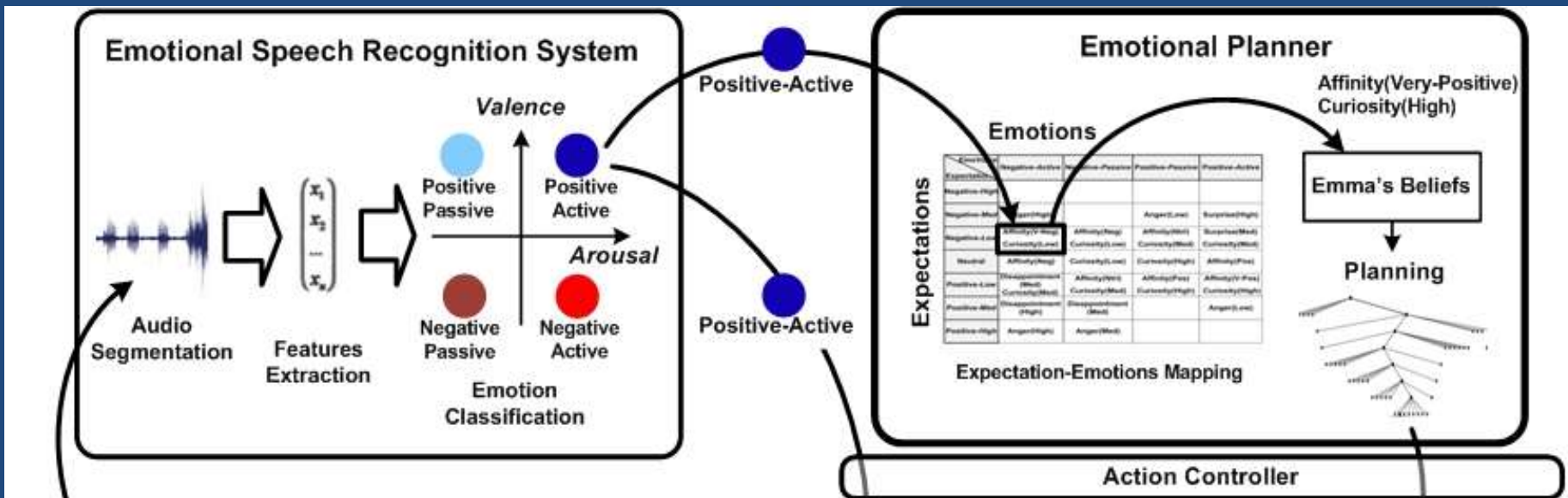
## Interactions in Ghost Mode





Interaction Mode  
- Actor -

# User Interaction (speech)



Participant talks to Emma

"Positive" Feedback Animation

Action "EMMA\_MENTIONS\_LOVE"



EMMA

- E\_ACCEPTS\_CONVERSATION\_WITH\_R 75.02 0 EMMA 0 EMMA 0.00 3 +
- R\_ACCEPTS\_CONVERSATION\_WITH\_E 82.53 0 EMMA 0 EMMA 0.00 3 +
- E\_START\_PLANNER\_S2.02 0 EMMA 0 EMMA 0.00 3 +
- E\_EXPRESSNEEDSOFCHANGE 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_SMILE 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_EXPRESSBOREDOM\_C 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_GETBETTERACQUAINTED\_R 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_BLUSH 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_SAYSTHGINCONFIDENCE 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_EXPRESSSATISFACTIONPRESENCE\_R 0 0 0 BO\_EMMAD 0 None 0 0 0 +
- E\_OFFERSGIFTTO 0 0 0 BO\_EMMAD 0 None 0 0 0 +

Type your message here

Log [E\_SILENCE] Send Send (L)

OFFER-GIFT-TO-R

PLEASURE DUTY



# User Interaction (physical)

Participant picking up flowers



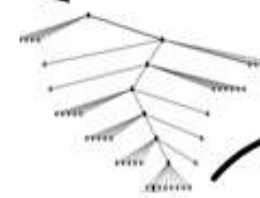
Emotional Category:  
"Positive-Active"

Recognised Action :  
"EMMA\_RECEIVED\_GIFT"

"Positive" Feedback  
Animation

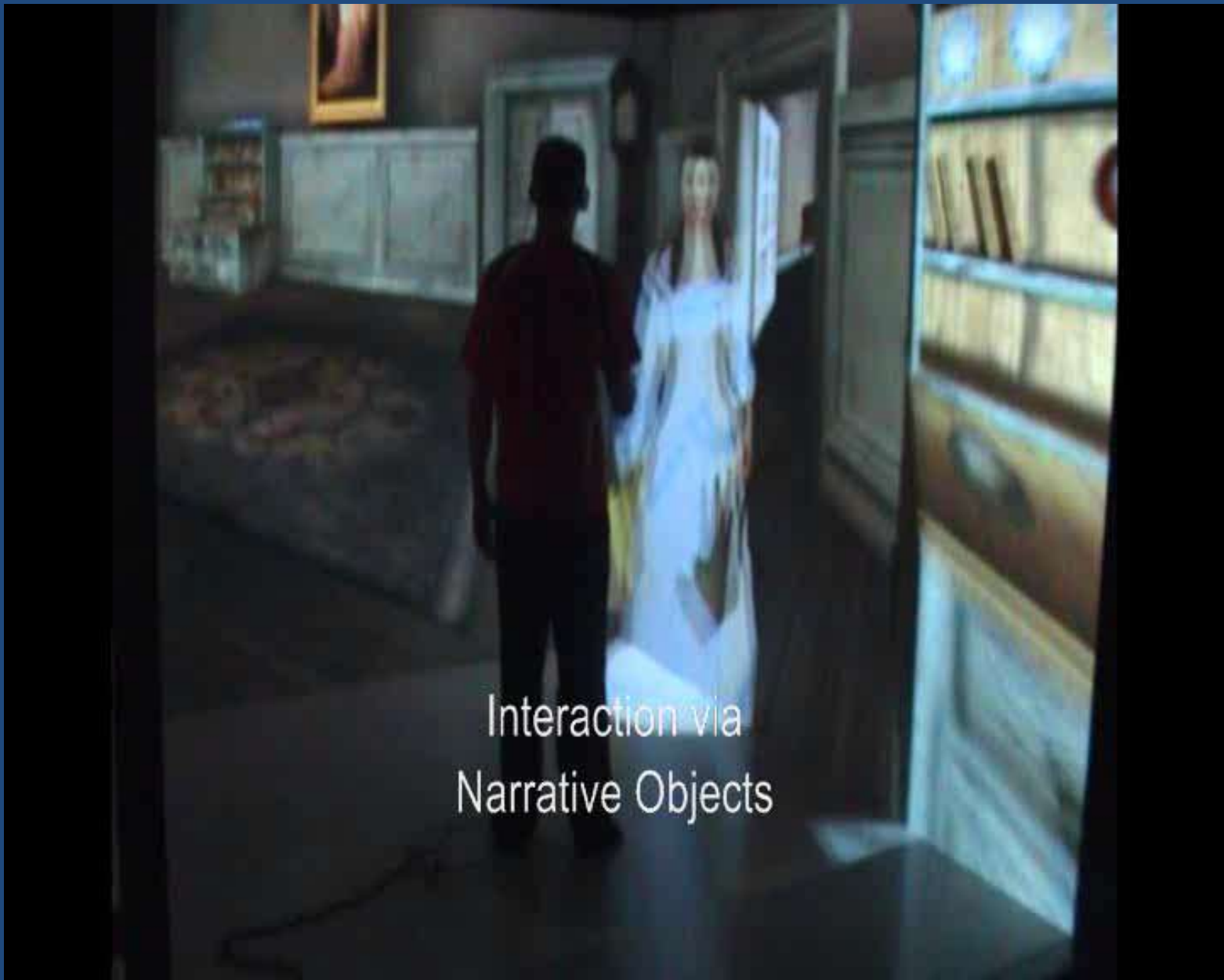
Emotional Planner

Planning



Generated Action :  
"EMMA\_MENTIONS\_LOVE"





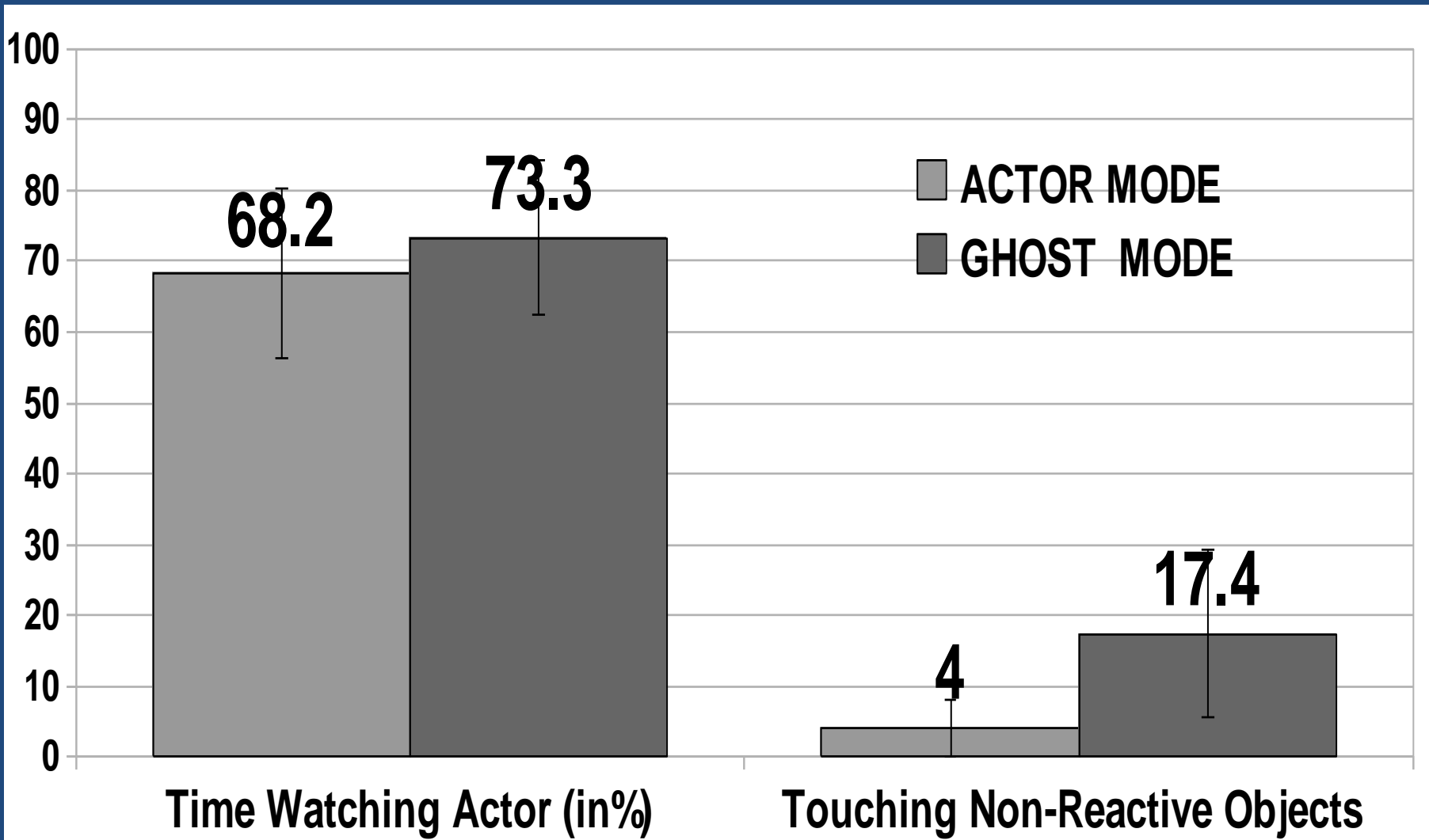
Interaction via  
Narrative Objects



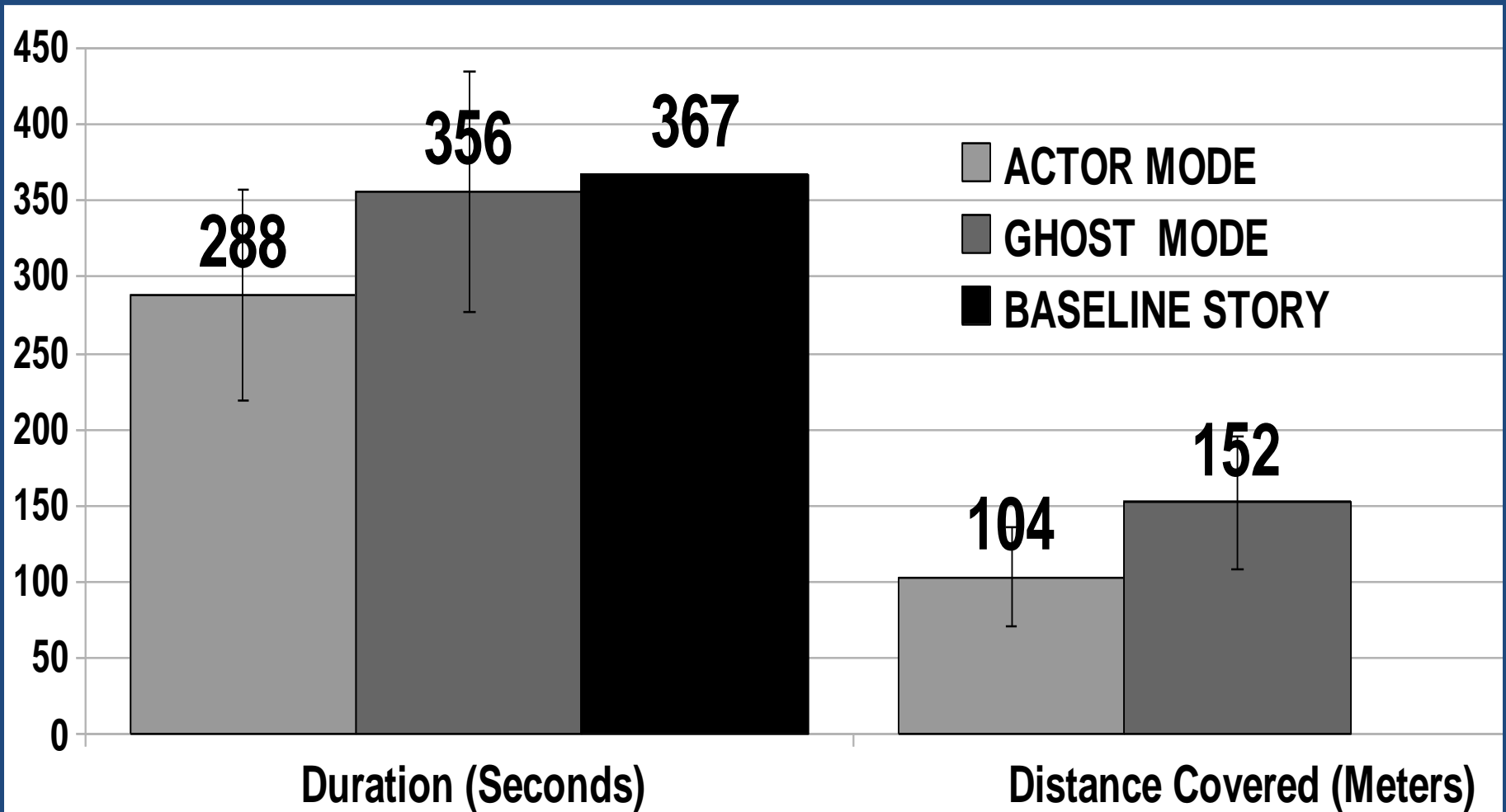
# User Experiments

- 38 subjects (20 male, 18 female), av. age 30.6 years
- all types, not necessarily gamers
- Session: av. 45 mn:
  - 10 briefing, 10 VR practice, 6 + 6 experiments, 15 questionnaires filling

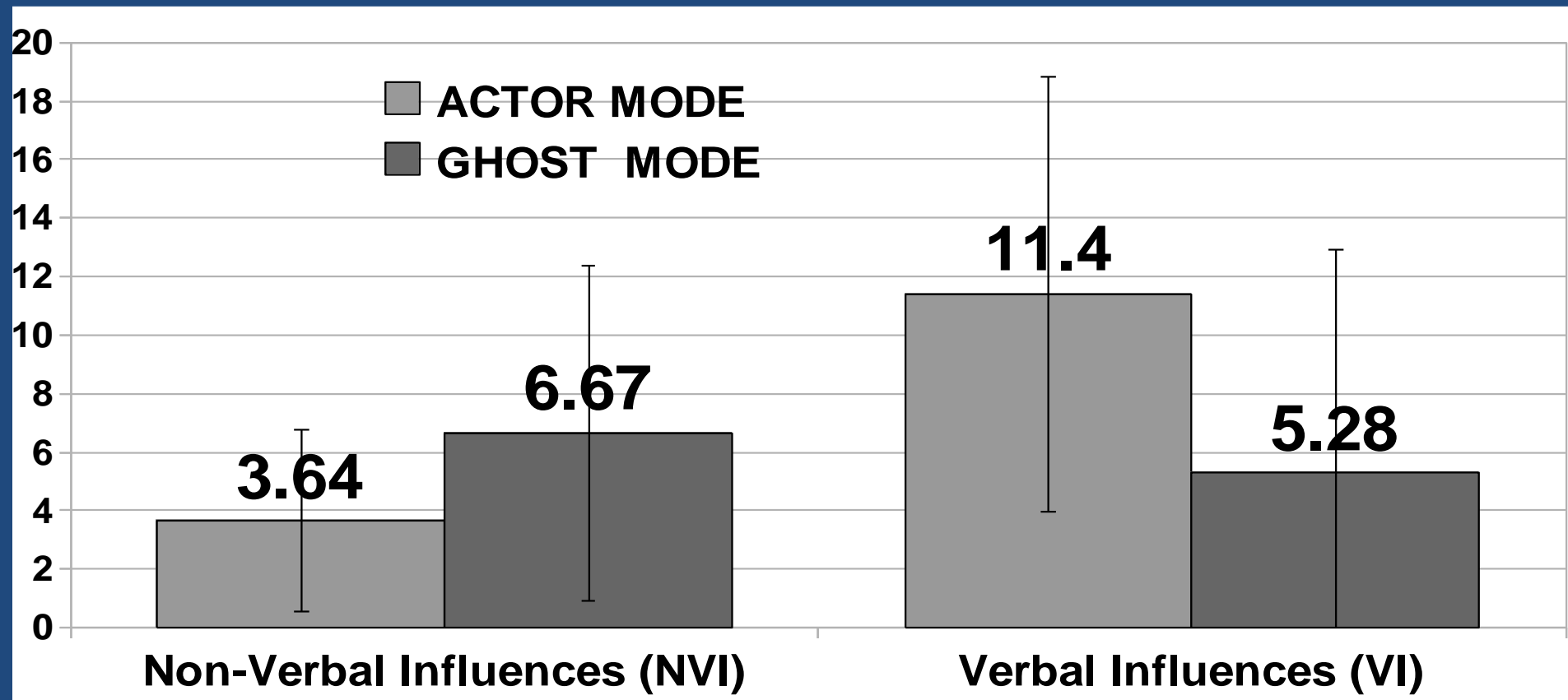
# User Experience: what they do



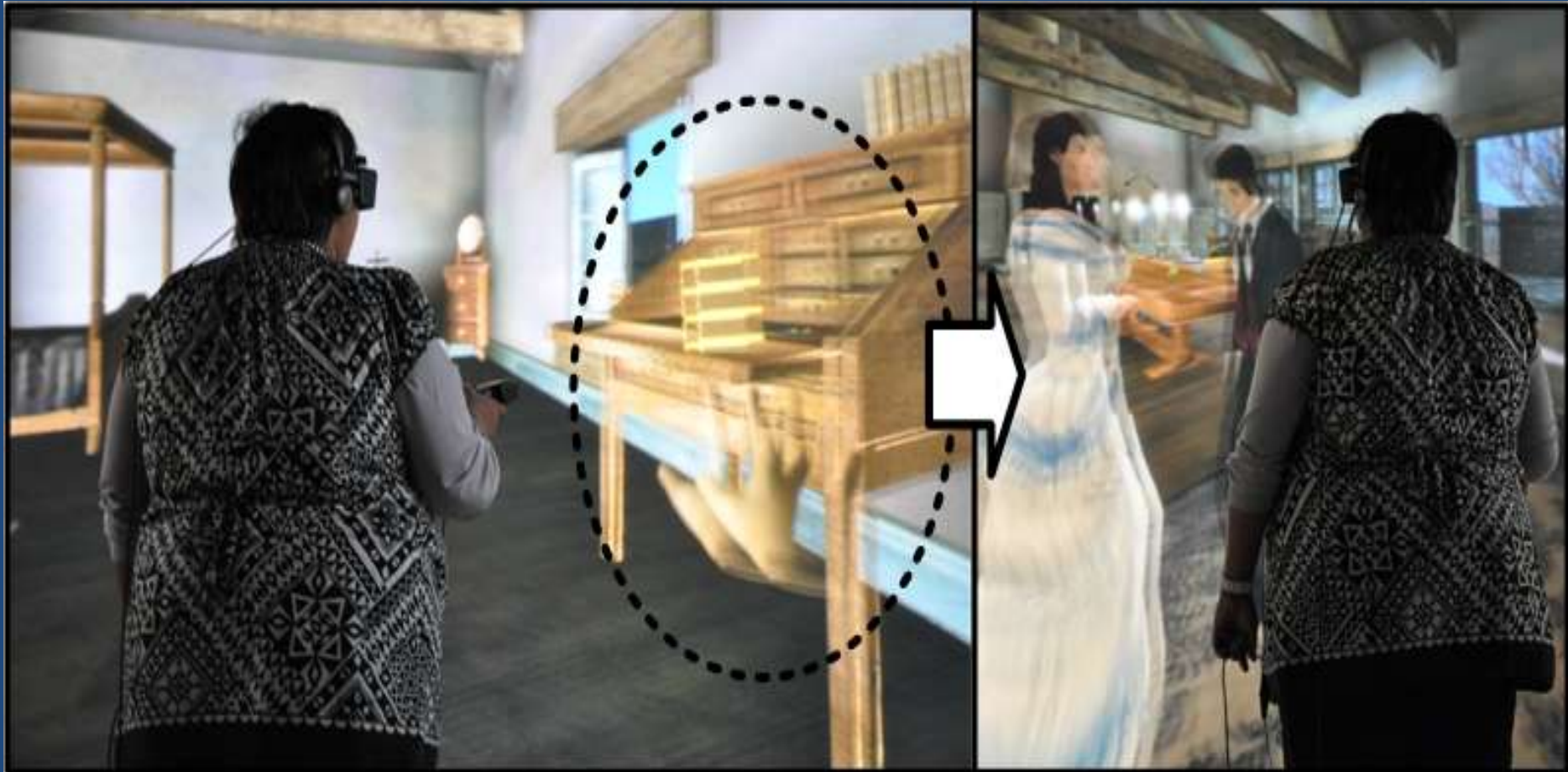
# Navigating stage and story



# User Interactions

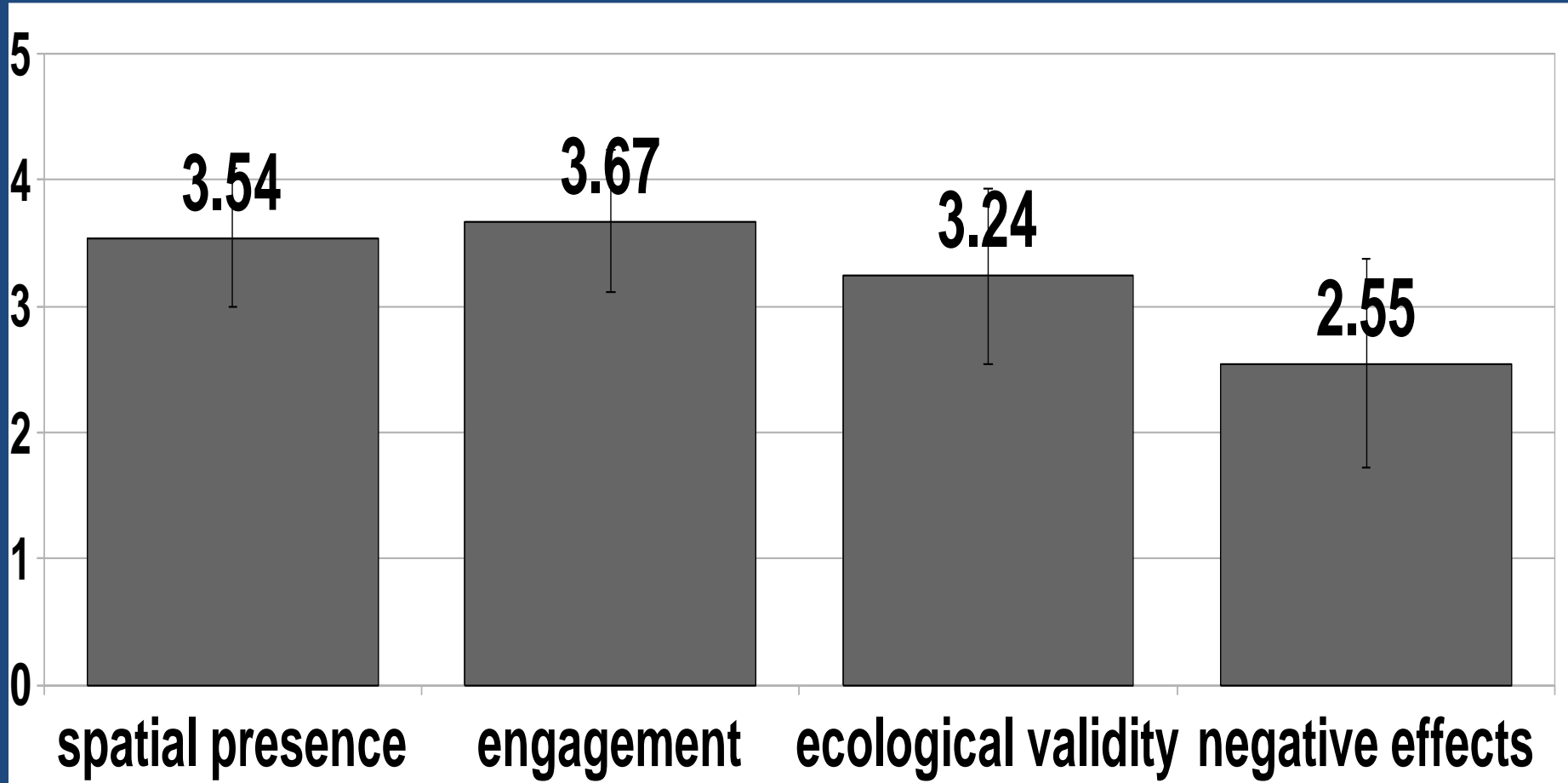


# User Influence





# ITC/SOPI Questionnaire



# Conclusions

- New technology that can support novel gaming genres
  - depend on other emergent technologies: speech recognition, 3D visualisation ...
- Change of perspective in Game AI: *knowledge representation* more important than algorithms

# Acknowledgements

- *Fred Charles , Jean-Luc Lugin, David Pizzi, Julie Porteous (Teesside University) ; Jeffrey Jacobson (PublicVR)*
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# Announcement: FDG 2011

## FDG 2011

An international conference covering the spectrum of digital games research.

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## INTRODUCTION

FDG 2011, the International Conference on the Foundations of Digital Games, is a focal point for academic efforts in all areas of research and education involving games, game technologies, gameplay and game design. The goal of the conference is the advancement of the study of digital games, including new game technologies, capabilities, designs, applications, educational uses, and modes of play.

FDG 2011 will include presentations of peer-reviewed papers, invited talks by high-profile industry and academic leaders, hands-on tutorials and topical panels on a range of subjects related to games research and education. We invite researchers and educators to share insights and cutting-edge results relating to game technologies and their use.

June 28<sup>th</sup> - July 1<sup>st</sup> (TBC)

# Further Reading

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