

# **Marlinspike: An Interactive Drama System**

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# Overview

- Intro: Interactive Narrative
- Theory: Interactive Narrative Poetics
- Intro: Interactive Drama
- **Marlinspike Design**
- Prototype game: *Demeter*
- Implementation
- **Evaluation**
- **Results**
- Conclusion

I'll just skim some of these. Watch for [**Tell Me More**] tags that mean I have more slides for the interested at the end.

# Interactive Narrative

"A narrative that changes in response to its audience"

- Usually means the *story* changes significantly  
(but could mean discourse or minor story elements)
- Usually means a narrative *artifact*  
(but could be a live performance)

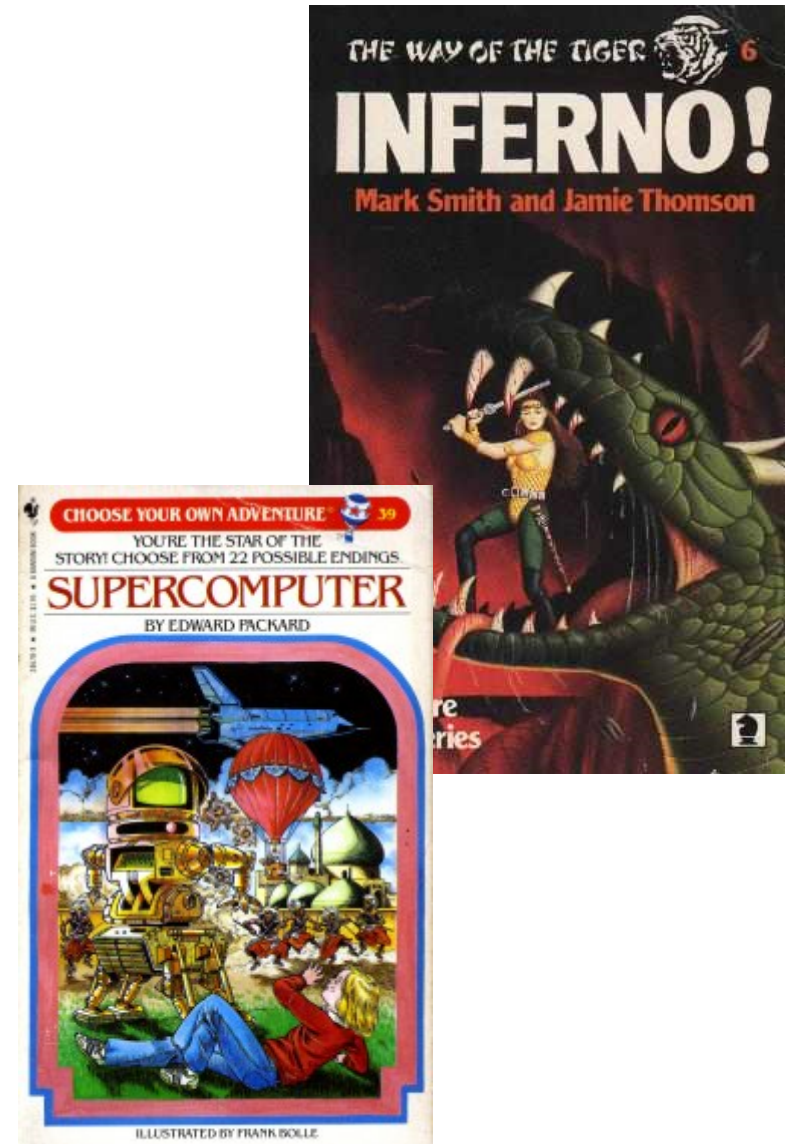
# Interactive Narrative Examples

## Traditional

- Roleplaying games (table-top and live action)
- Improv theater
- *Choose Your Own Adventure* and gamebooks

## Digital

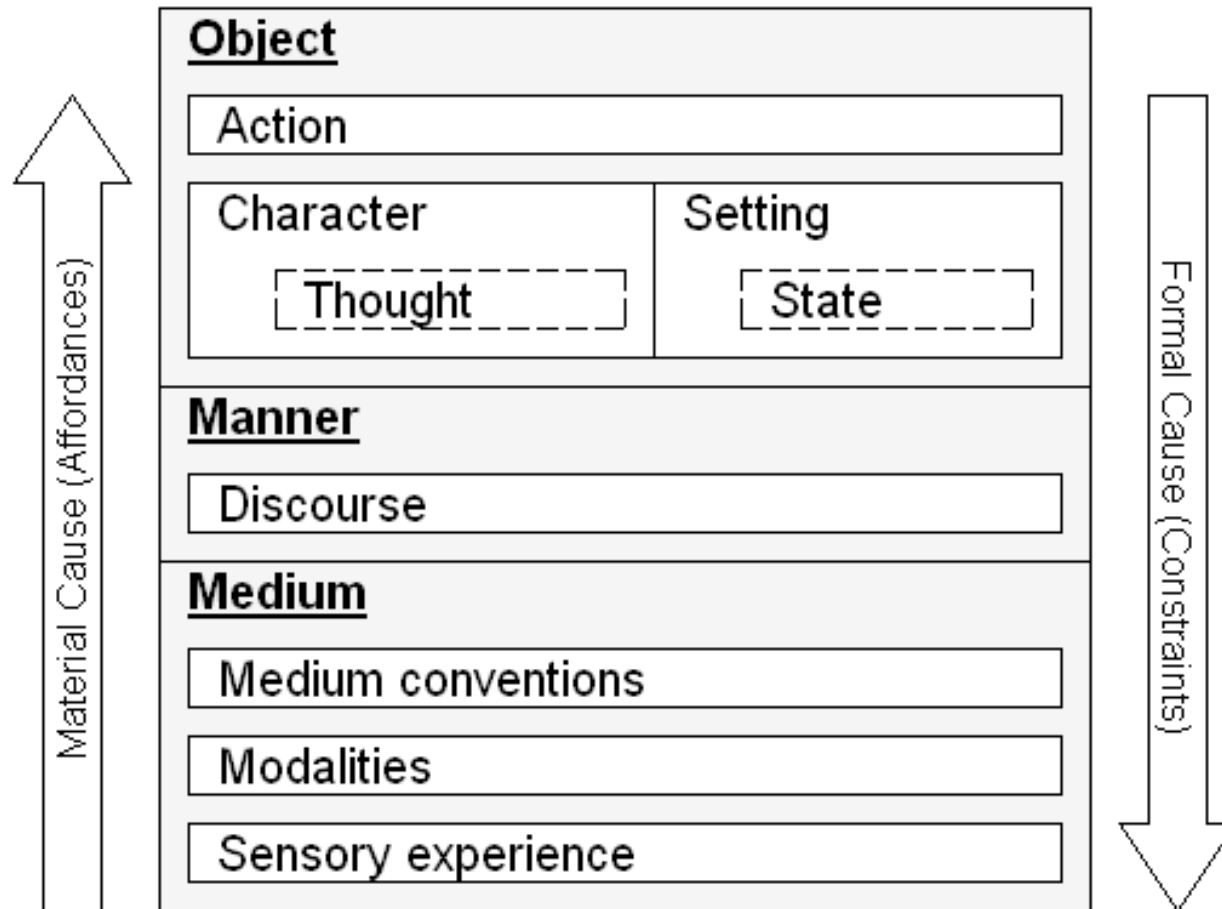
- RPG and adventure computer games
- Digital literature (Flash stories, hypertext fiction, etc.)



# Theory: Narrative + Interactivity

- Start with narrative.
- What is *narrative*, exactly?
- Start with the basics... at the beginning... Aristotle!
  
- Other narrative theory: Gustav Freytag, Vladimir Propp, modern narratology (esp. Seymour Chatman). But the basics are fairly constant.
- And existing interactive narrative theory: (Aristotle), Brenda Laurel, Janet Murray, Michael Mateas. But a few minor problems there.  
[Tell Me More]

# "Poetics" Model of Interactive Narrative



**Agency:** User's (sense of) ability to make significant change in system in accordance with user's intention. Requires a balance of material (affordances) and formal (constraints) causes.

# Structure of Action (story)

Most important two aspects:

- **Unity**

All events are connected by necessary or probable cause to produce a unified whole

"the structural union of the parts being such that, if any one of them is displaced or removed, the whole will be disjointed and disturbed. For a thing whose presence or absence makes no visible difference is not an organic part of the whole" (Aristotle)

- **Completeness**

A beginning, middle, and end, defined in terms of causes.

Also: Of a certain size to allow for a change of fortune, may exhibit certain morphological structures, exceptions to the rules, etc.

# Interaction Levels in Interactive Narrative

<b><u>Object</u></b>	
Action	} Directorial control
Character	} <b>Interactive Drama</b>
Setting	} Interactive agents/virtual world
Thought	
State	
<b><u>Manner</u></b>	
Discourse	} Discourse control (mood)
	} Some hypertext fiction / Digital lit
<b><u>Medium</u></b>	
Medium conventions	} Influencing live performance
Modalities	} Traditional narrative artifacts
Sensory experience	(turning pages; play/pause, volume control)



# Interactive Drama

- Player assumes the role of a character in a virtual world
- Player's interactions with that world become part of a well-formed story
- Story is generated at run-time rather than completely pre-authored
- Experience: like RPG game (table-top or computer)
- Frequently: digital; believable characters; focus on social interaction (over combat and problem-solving)
- **Synonyms:** digital storytelling, interactive story, etc.
- **Not:** interactive fiction, which means "text adventure" <sup>9</sup>

# Interactive Drama Challenges

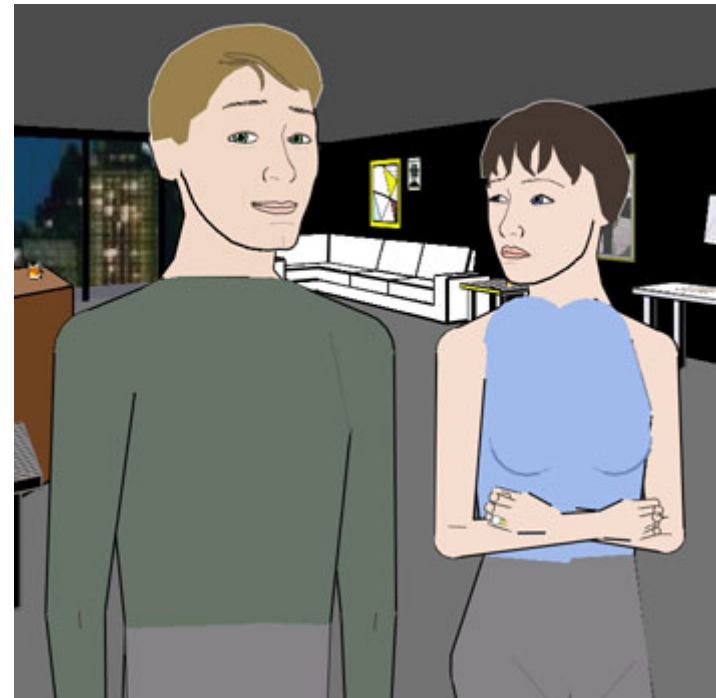
- **Author control vs. player freedom**
  - similar tension: plotted story vs simulated world
  - need to balance, not just offer one or the other
  - User agency, especially at the story level
- **Authorial load vs. story generation**
  - especially with limited AI knowledge of the real world and of good stories
  - no branching plot trees!
  - quality control

# Existing Interactive Drama Development

- Different approaches to the problem: emergent from world/character simulation, planning, search-based, etc.
- I am interested in scene-based approaches – building a story from small pre-authored story segments
- Other related systems:
  - Crawford's Erasmatron (2004+)
  - Grasbon & Braun's Geist (2001)
  - Fairclough's OPIATE (2005)
  - Tomaszewski's Eudaemon (2007)
  - Mateas & Stern's *Facade* (2005)

# *Facade*

- Best example so far from modern digital interactive drama community
- By Michael Mateas and Andrew Stern (2005)
- Took 5 years to design and build



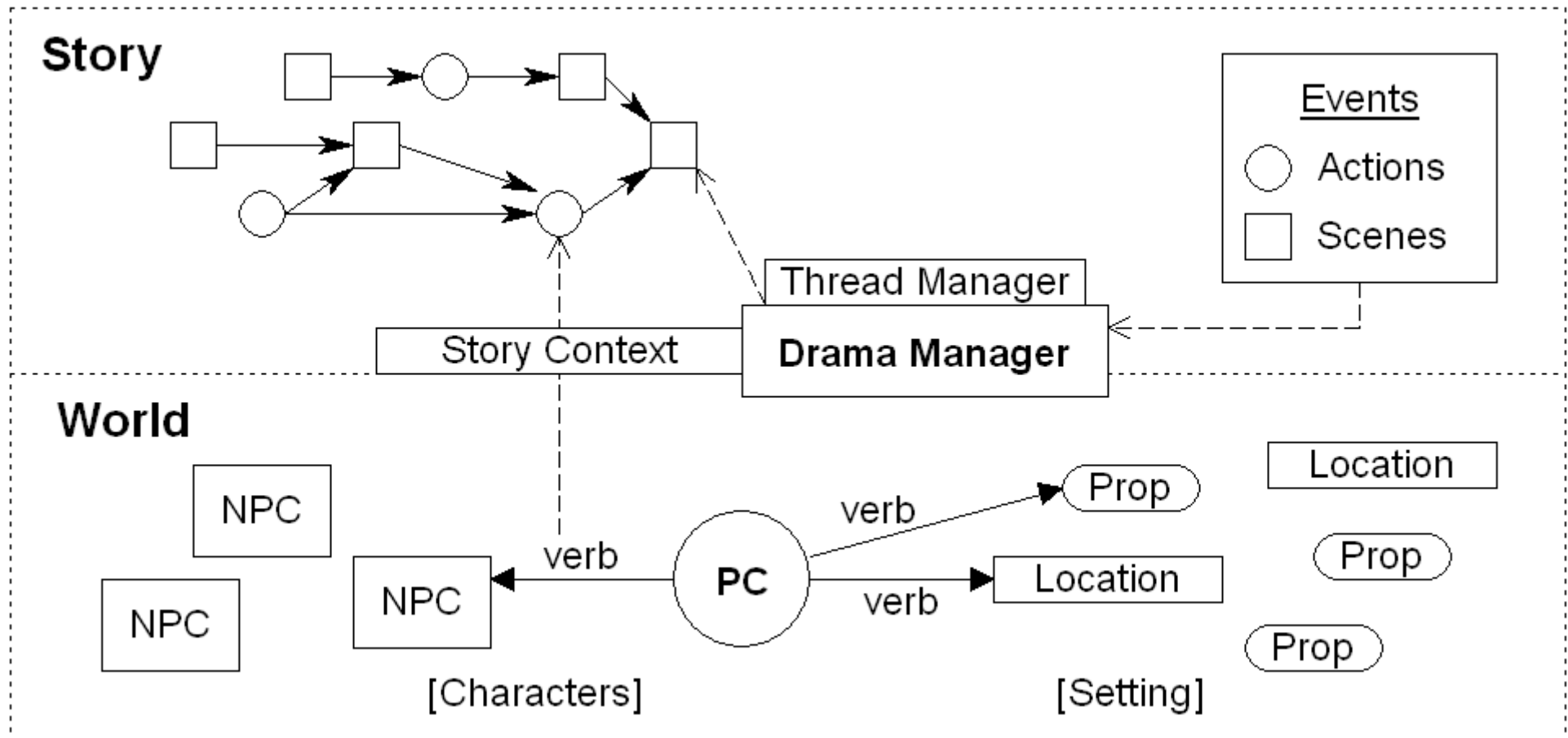
From: [interactivestory.net](http://interactivestory.net)

# Marlinspike

So there are many other approaches to interactive drama, but this is mine:

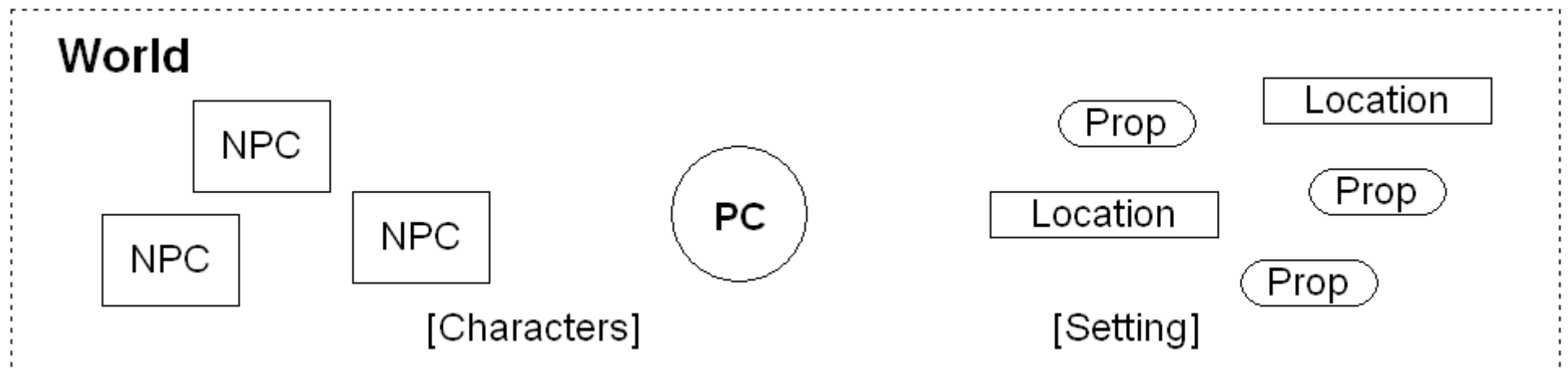
- Story directed by centralized *drama manager* agent
  - (vs: emergent from autonomous character agents)
- Bag of pre-authored scenes
- Simply reactive (does not plan ahead)
  
- Prototype system/game is text-based.

# Marlinspike System Architecture



# World

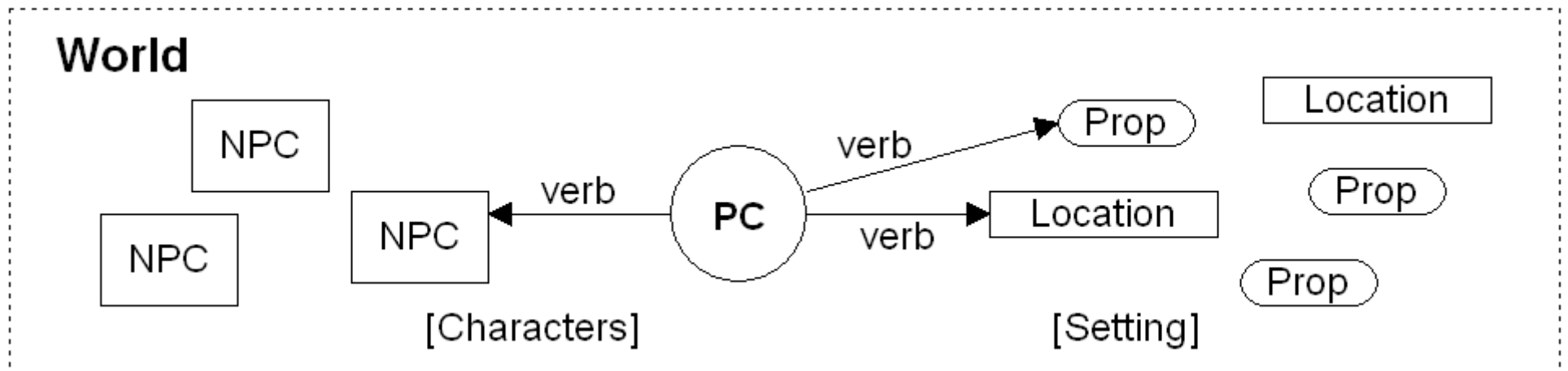
- Setting (locations, props)
- Characters (PC, non-autonomous NPCs)



# World-level interaction: Verbs

"Physical" interactions player can perform in the world.

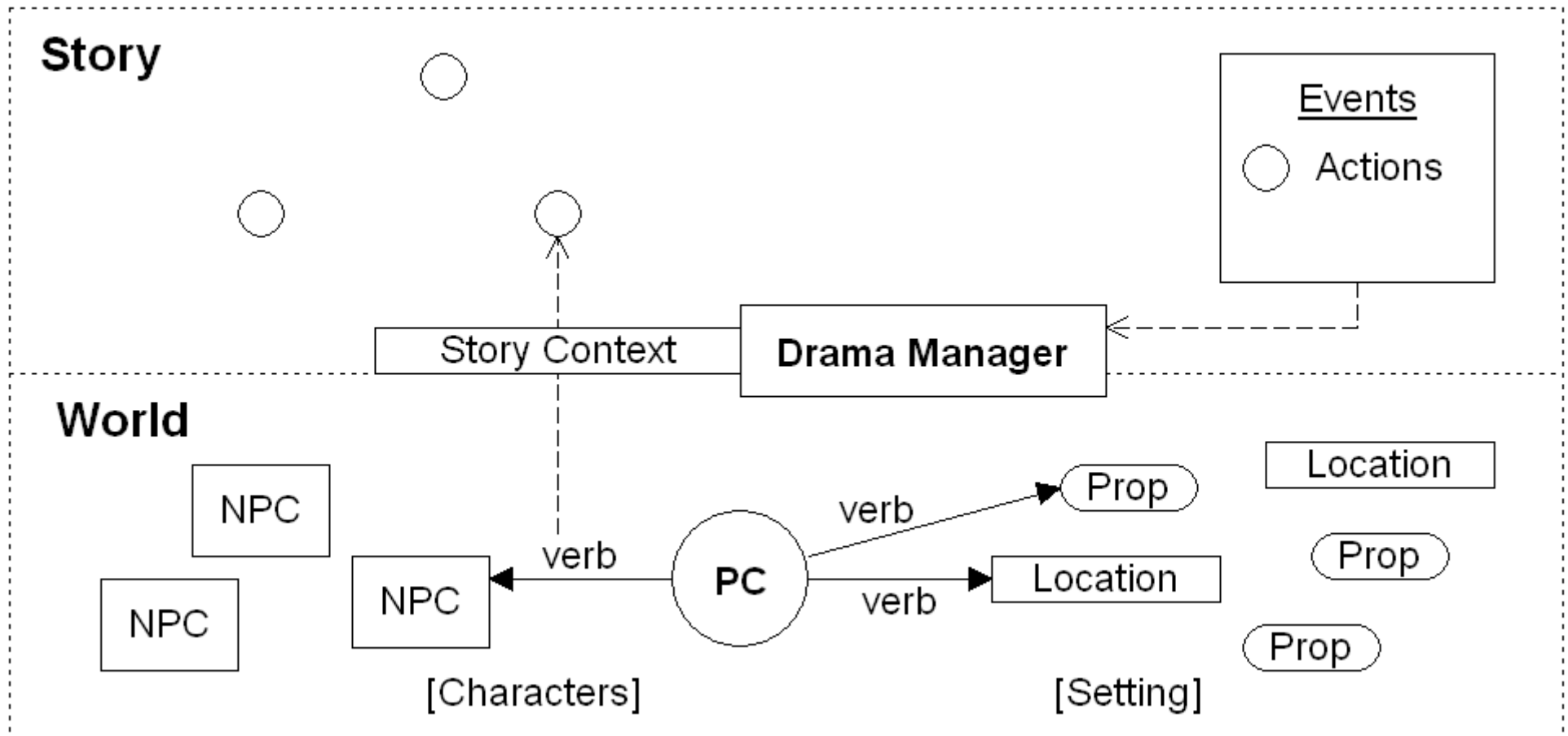
- Examples: **Take, Drop, Talk, Attack, Kiss**
- Verbs affect world state
- Produce deeds: PC Take(hammer)
- Results are narrated





# Story

Each deed then represented as story-level event (*action*)



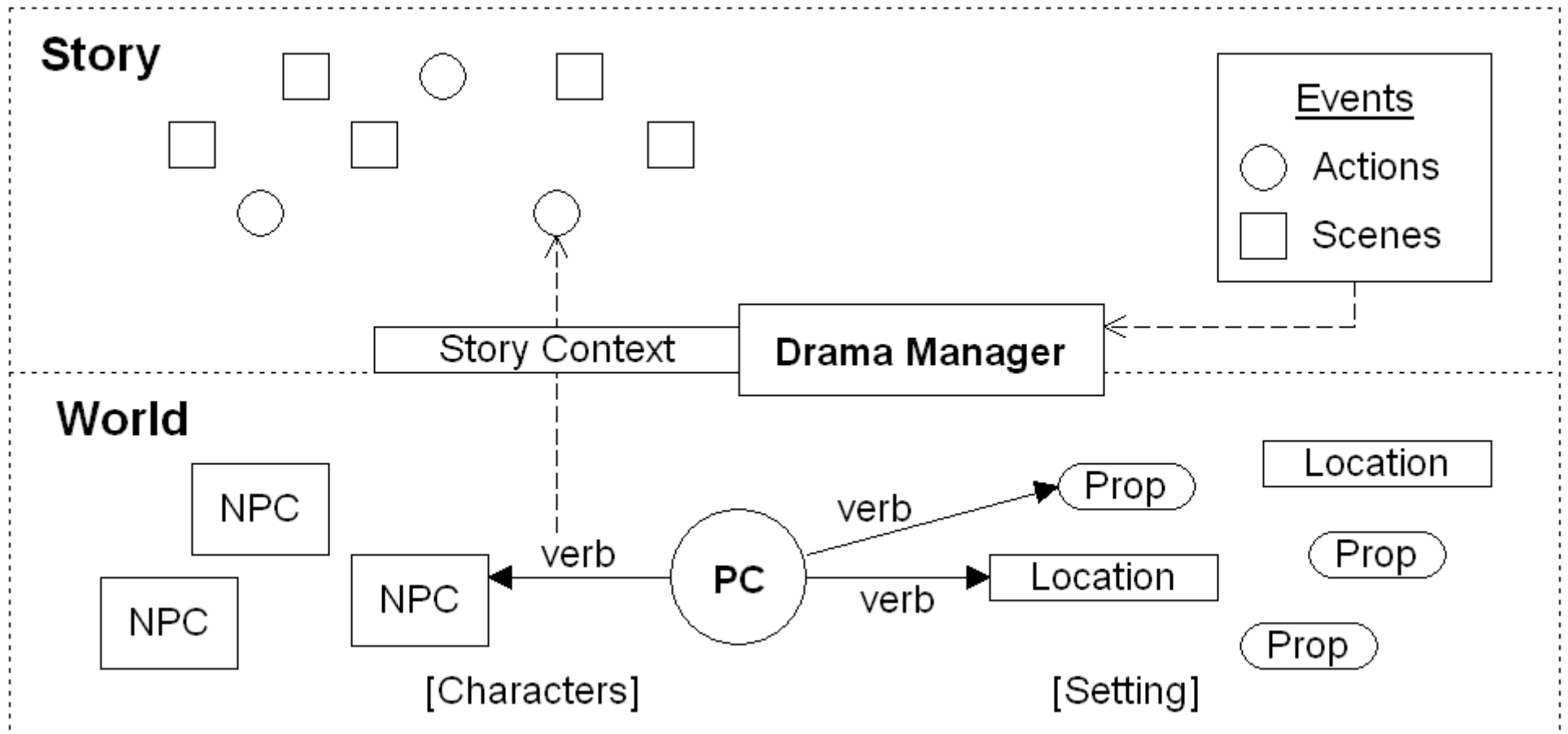
# Story-level Interaction: Actions

Actions translated from verbs by default *casting* rules

- Examples: MANIPULATE, ASSAULT, ROMANCE, RESCUE
- Translation can be affected by world state:  
**Kiss (Alice)** -> ROMANCE(Alice) or ASSAULT(Alice)
- Translation can be overridden/extended by story context:  
**Kiss (Alice)** -> RESCUE(Alice) or BETRAY(Betty)
- Actions can also affect world state but are not narrated
- Each deed may be represented by more than one action
- Each action has an import value

# DM response: Scenes

DM responds to actions by playing scenes



# DM response: Scenes

- Selected from a pre-authored collection
- Each is either a beginning, middle, or ending scene
- Middle and ending scenes have preconditions
- Most are template-like in that they fill in many specific details at runtime (choosing NPC to act, what to say, etc.)

Scenes advance the story by:

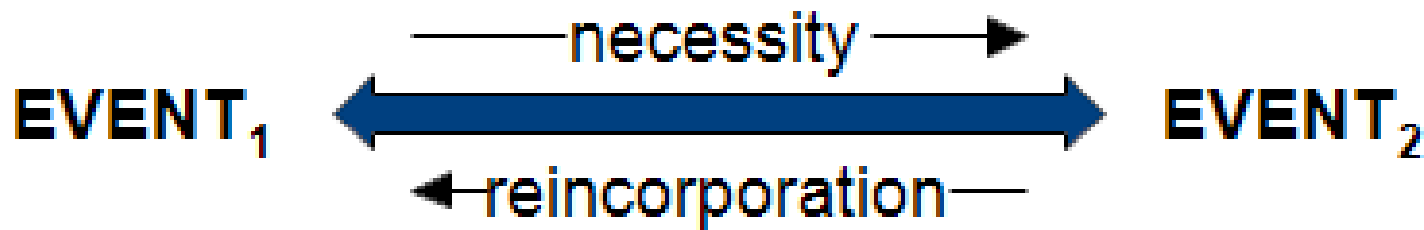
- Providing actions and reactions of NPCs
- Affecting world state
- Setting up story context (*triggers*) for later verb-action translations

Most game narration comes from scenes. Scenes can be a single line of dialog to a summary of hours of action.

# Story Structure: Reincorporation => Unity

Reincorporation (Johnstone 1979 / improv) of previous events makes them necessary (Aristotle) to the finished story.

Example: PC is a questing hero in a fantasy setting. Insults an old man in an inn and he leaves in a huff. Many ways to bring the old man—or even just the insult—back into the later story. But if not done, this scene would be unnecessary to finished story.

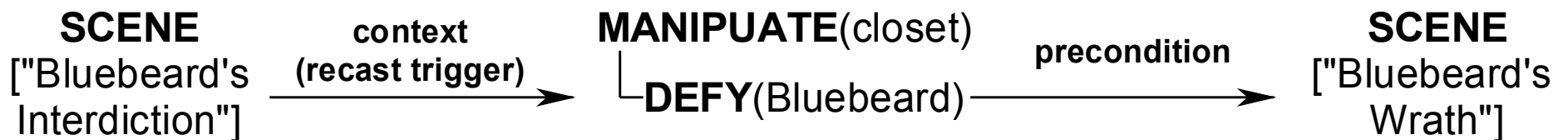


# Story Structure: Reincorporation Threads

Reincorporation techniques:

- A previous event is a *precondition* for the current event
- A scene refers to a previous event (*hook*)
- An earlier scene provides *context* for the current verb-to-action translation

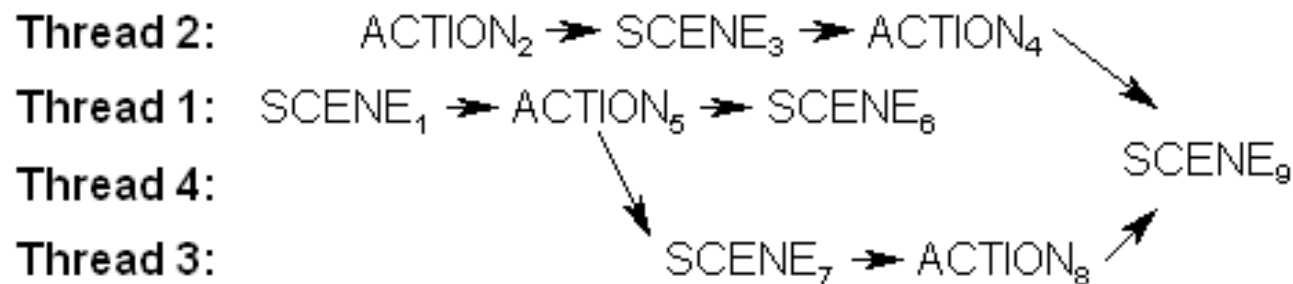
Only required to do this for actions and scenes of high import



[An Example Reincorporation Thread]

# Story Structure: Splicing

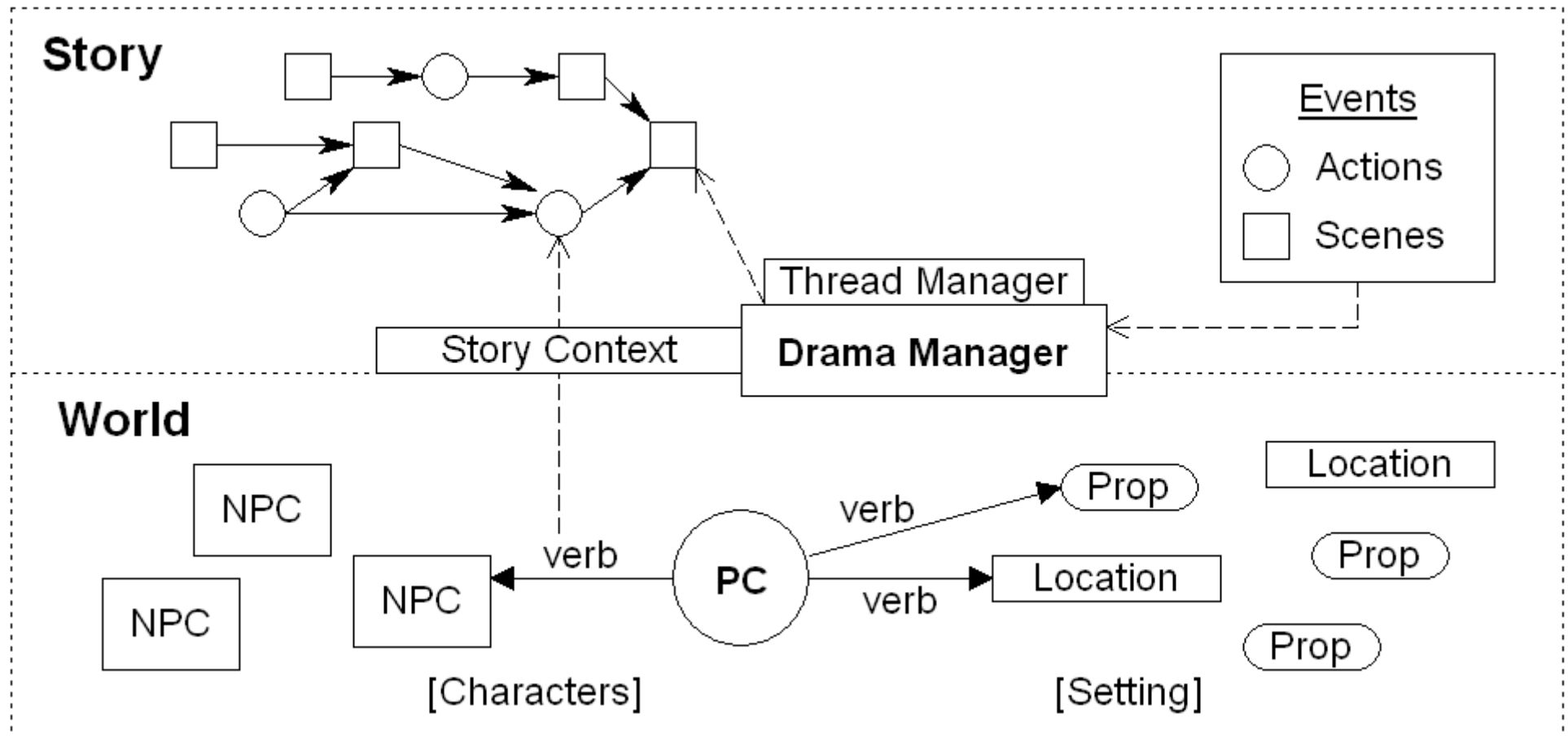
- So Marlinspike DM selects next scene to play so as to reincorporate the most previous material as possible
  - Improved scene relevance
  - Reincorporates extraneous player actions into a unified story



Splicing two or more threads together is the source of the name *Marlinspike*, which refers to the fancy rope-work of old-time sailors.

# Marlinspike System Architecture (again)

(Note the similarity to Poetics structure.)





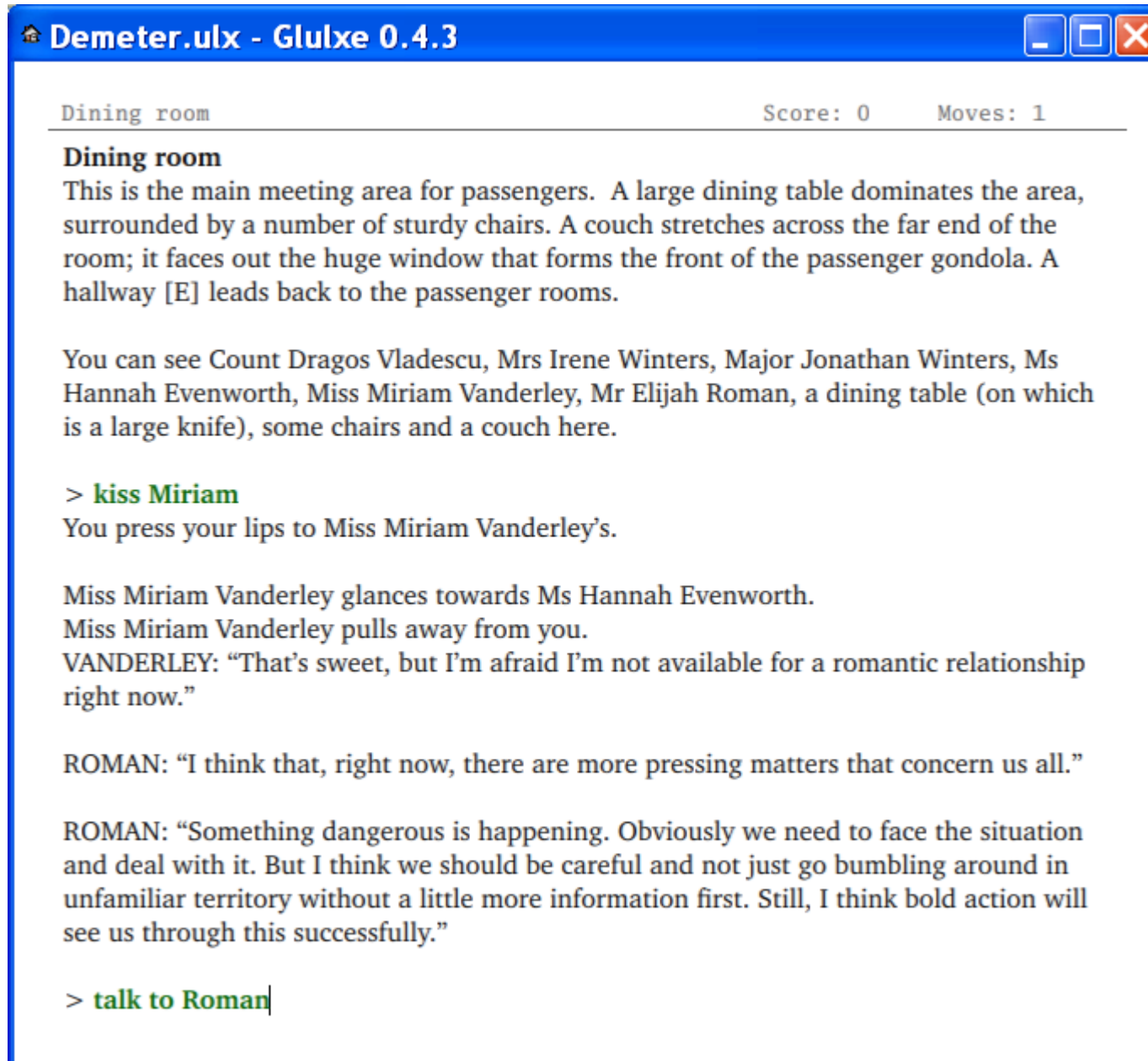
# Prototype Game Needed

- Marlinspike deals only with abstract story structure
- All story-specific content – world (props and locations), characters, verbs, actions, and scenes – left to the implementing game
- So need a specific game to test Marlinspike
  
- For ease of implementation, went text-based. Used an interactive fiction system/language named Inform
- Wrote Marlinspike within Inform too

# ***Demeter: Blood in the Sky***

- Horror story set on a trans-Atlantic Zeppelin flight in an alternate 1923
- Passengers (including PC) wake on 3<sup>rd</sup> day to find the crew all brutally slain... and *something* lurking in the Zeppelin above.

# Demeter Screenshot



# Implementation: Marlinspike + *Demeter*

- A little over 2 years coding (just me, part-time)
- ~23,000 lines of code (15% Marlinspike)
- ~9,000 lines of documentation (28% Marlinspike)
- Many lessons learned [Tell Me More]

## Demeter:

- 18 locations ("rooms")
- 6 passenger NPCs (+ revenant)
- 27 verbs
- 26 actions
- 26 scenes (+3 components & 13 NPC reactions)
- In-game tutorial scenario (~10 minutes)
- Main game takes about 20 minutes to play

# Evaluation: Claim

- **Reincorporation feature will produce a better interactive narrative experience**
- Specifically:
  - Narrative → well-formed story structure (unified and complete)
  - Interactivity → story-level agency
  - Experience → self-reported player response

*H1:* Reincorporation produces a better-formed internal story structure.

*H2:* Reincorporation provides greater user agency at the story-level.

*H3:* Reincorporation produces higher user ratings of story coherence and structure.

*H4:* Reincorporation produces higher user ratings of story-level agency.

# Independent Variable: Reincorporation

- Marlinspike selects scenes first based on what can be played (required *preconditions* are met).
- Then it selects from this set the scene that reincorporates the most thread material through its *preconditions + hooks*
- Scene content will change when narrating any hooks
- When reincorporation is turned off:
  - 1) second step of selection is skipped so a possible scene is simply picked at random each turn, and
  - 2) no optional previous events are *hooked in* when the scene plays.

# Experimental Procedure

- Recruited by email. Clicked a link to participate online.
- Randomly assigned to two groups
- Consent and Background Questionnaire  
(Age, gender, education, comfort/frequency of computer use, familiarity with computer/narrative games, etc.)
- Short interactive fiction tutorial (set in the story world)
- Played through game twice: once with reincorporation on and once off. Transcripts of input sent to server.
- Answer same short survey after each time (ratings and a few short answer questions).
- Group 0: Played with reincorporation ON then OFF  
Group 1: Played with reincorporation OFF then ON.

# Results: Recruitment

- Clicked link in email (ID assigned): 102
- Completed Background Survey: 53
- First game survey completed: 35
- Second game survey completed: 29
- Of these:
  - 2 quit halfway through games
  - 1 played twice before first survey
  - 2 missing transcripts for first game (Mac issue?)
- So: **24 complete participants**

[Participant Backgrounds: **Tell Me More**]



# Results: Groups

- Group 0 (reinc ON, then OFF): 15 participants
- Group 1 (reinc OFF, then ON): 9 participants
- Significant differences ( $p < .05$ ) between group means on:
  - Number of digital games played (both PC and non-PC)
  - Familiarity with IF and adventure game genres
  - Familiarity with table-top roleplaying games
- But there was no significant difference between group means for any later measures.

# Results: Game Session Means

- Tutorial + first game: 28 minutes
- Second game: 15 minutes
- (Longest game: 94 minutes; shortest: 5.5 minutes)
  
- Tutorial: 38 commands entered  
(StdDev = 19; max = 87; min = 20)
- Game sessions: 75 commands entered  
(StdDev = 37; max = 175; min = 27)
- No significant difference in commands entered between first and second game sessions, but played significantly faster second time (4.5 cpm vs 5.9 cpm)

# H<sub>1</sub>: Reinc => Better Story Structure? Yes!

- All stories were **complete**, regardless of reinc (Beginning, middle, and ending scene in same thread)
- When reinc was on, games were about 75% shorter on all story-level measures. So more concise. (root events, user deeds, root scenes, total events) ( $p < .05$ )
- Significantly more **unified** on all measures ( $p < .001$ )

Measure	Reinc ON Mean	Reinc OFF mean
Main Thread Size	28.6 events	13.9 events
Main Thread Weight	15.6	12.0
Threads Spliced	3.2	1.0
Extra Threads	5.5	12.3
Unthreaded Unique Weight	22.8	58.0

## H<sub>2</sub>: Reinc => Story-Level Agency? (prereq)

World-Level Agency is a prerequisite:

- Only 80.5% of inputs resulted in a valid deed (StdDev = 10.7; max = 100%; min = 50%)
- This significantly improved between games ( $p = .01$ ) (First game mean: 76.6%; Second game mean: 84%)
- Reincorporation made no difference to this (as expected)

## H<sub>2</sub>: Reinc => Story-Level Agency? (range)

Measure	Mean	Max	Min
Mean Action Import	2.5	2.9	2.1
Significant Action Count	3.2	12	0

- Import ranges from 1 to 9, so mean is low. Most actions in *Demeter* involve looking (1), moving (2), talking (3).
- Significant actions: Import of 4 or more  
Sufficient to start new thread (if doesn't extend an existing one)
- Reincorporation and play order to not affect the range of actions people use

## H<sub>2</sub>: Reinc => Story-Level Agency? Yes!

Measure	Reinc ON	Reinc OFF	<i>p</i>
% of Actions in Threads	59%	51%	.053
% of Actions in Main Thread	37%	13%	< .001
Significant Actions in Main Thread	1.4	0.2	.008
% of Significant Actions in Main Thread	44%	4%	< .001

- Still many actions (even significant) being left unnecessary to finished story
- But very significant improvements: 3x more actions into main thread, and 11x more for any significant actions
- No difference from play order

### H<sub>3</sub>: Reinc => Better Player Story Experience? No

- No significant difference between reinc ON vs OFF.

Survey Question	Response (4 to 0)
The events of the game had a story-like structure.	3.27
The game session had a clear beginning, middle, and end.	2.48
The events of the game were logically related to each other.	2.94
Earlier events led to later events in a coherent and understandable way.	2.73
The other characters' actions seemed to be consistent with their apparent goals and personalities.	2.70

### H<sub>3</sub>: Why not?

- Scenes are 1) From relatively small possible story space and 2) must have preconditions met. So extra selection step is small improvement
- Turning off hooks changes most scenes by only one or two sentences. And participants likely inferring these connections even when reincorporation is off.
- So effect is quite subtle. Maybe a 9-point Likert scale could have helped capture this.



## H<sub>4</sub>: Reinc => Better Player Story Agency? (pre)

World-level agency is a prerequisite:

Survey Question	Response (4 to 0)
I knew what actions were possible to perform within the game.	2.77
I was able to construct commands that the game understood.	3.00
I was sufficiently able to direct my character's actions in the game world, such as move from place to place, manipulate objects, talk to other characters, etc.	2.90

- Noticeable small group that did not know what actions were possible.
- Significant correlation with system measure of world agency; did not signif. vary with play order or reinc.

# H<sub>4</sub>: Reinc => Better Player Story Agency? (pre)

World-level agency is a prerequisite:

Survey Question	Response (4 to 0)
I entered a command that caused an error message or that the game obviously did not understand.	1.71
I entered a command that the game seemed to understand but that did not have the effect I intended in the story world.	1.32

- 1 = Rarely, 2 = Occasionally
- Significant negative correlation with system measure of world agency; reported errors less frequent on second game

## H<sub>4</sub>: Reinc => Better Player Story Agency? No

- No significant difference between reinc ON vs OFF.

Survey Question	Response (4 to 0)
My actions seemed to have a significant impact on the course of the story.	2.21
I believe the story would have been different had I performed different actions.	2.83
I believe the story would have been better had I performed different actions.	2.63

- Fairly wide distribution on first question, but still curved and centered on Neutral

## H<sub>4</sub>: Why not?

Open-ended questions provided some possible explanations:

- World-agency too low. (Text-based interface least enjoyed aspect of game; complaints of not knowing what deeds are possible)
- Opinion covers a wide range: 35% of most memorable events and 25% of most enjoyed aspect => agency; but 15% of least enjoyed aspect => lack of agency.
- Agency requires formal constraints, and some complained that an objective was not clear/provided.
- Not enough high import actions afforded

# Extras: User Satisfaction

- Game was enjoyable: **2.5** / 4.0  
Wide distribution: SA(12) A(12) N(15) D(8) SD(1)
- Enjoyment was significantly correlated with ratings of:
  - Logical relations between events
  - Earlier events coherently leading to later events
  - Consistent NPCs
  - Player actions having a significant impact on story
- Interesting: ID experience corresponds with enjoyment. (But what causality is at work here?)

# Extras: Open-ended Questions

- Asked for most memorable event, most enjoyable aspect of the game, and least enjoyable aspect.
- Responses highlighted that **all** levels of narrative are important: story, characters, setting, narration (particularly mood), and medium (text, both input and output).
- So interactive drama requires much more than just story management!

# Conclusion

- Reincorporation works great... internally.
- Users don't notice it though.  
(Good thing I didn't simulate the users.)
- From Implementation: More needs to be considered in scene selection.
  
- Text-based interactive drama is viable, but affordances need to be improved.

# Conclusion: Contributions

- Theory: Solid poetics model to guide development
- Theory: Reincorporation ==> narrative necessity
- Marlinspike: Translation of deeds to actions
- Marlinspike: Player actions are explicit modeled as story atoms on par with scenes. (Other systems only let players interact within scenes.) Corresponding authorial focus on player agency.
- Marlinspike: Explicit detail of resulting internal story structure
- Marlinspike: Decently solid (2.5 stars) ID system
- Implementation: Personal lessons to improve system



# Conclusion: Future Work

- Theory: Can reincorporation really improve user experiences of story structure and agency?
  - Could test with much simpler hypertext choose-your-own-adventure story with only story-level agency. (This is not ID, but should be relevant.)
- Marlinspike improvements
  - Re-implement in robust language
  - Object-centered menu-based IF system
  - Ways to break down scenes into components
  - Plugging DM into different game engine front-ends
  - Long-term: a modular ID game architecture for R&D<sub>49</sub> ("Midgard"?)

# Conclusion: Future Work (Short Term)

- (Catch up on other life details: TA grading, classwork, taxes)
- *Demeter* is already online, but a few bugs left from study
- Clean up docs and release code
- Format/polish up dissertation document
- Graduate (?)
- Report/publish results so far

# Questions or Comments?

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**[Tell Me More]:**

Poetics Model / Implementation Lessons / Participant Backgrounds

# Tell Me More: Poetics

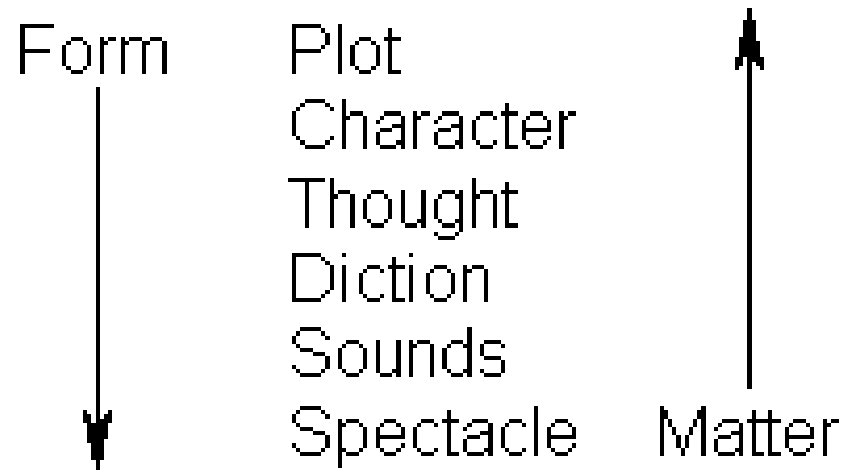
# Aristotle's *Poetics*

Art, such as drama, has 3 parts:

- **Object**
  - an imitation of “men in action”
  - Comprised of: Plot, Character, Thought
- **Medium**
  - means by which action or object is conveyed
  - Diction, Song
- **Manner**
  - Manner in which the object/story is portrayed
  - narrated (told) or enacted (performed)
  - Spectacle

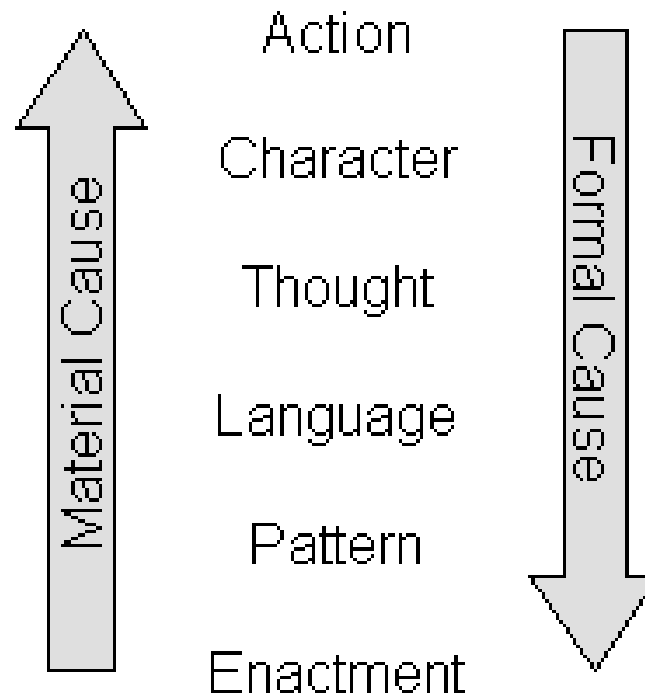
# Smiley's *Playwriting* (1971)

- Takes Aristotle's parts of drama in order of importance
- Adds Aristotelian concept of formal and material causes



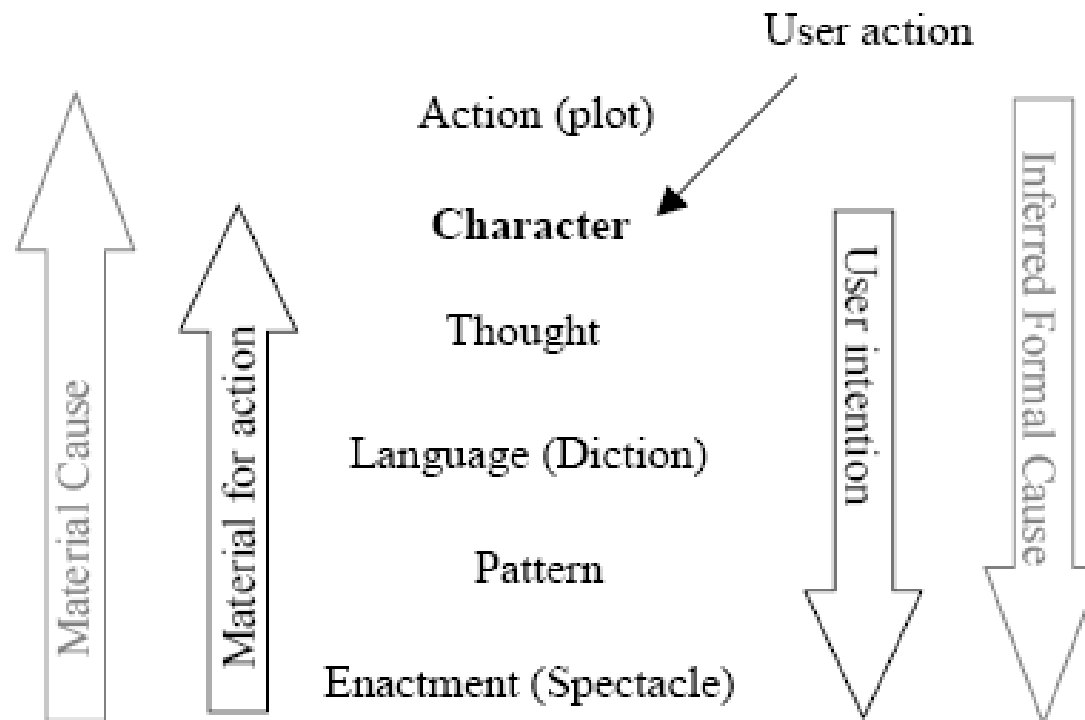
# Laurel's *Computers as Theater* (1991)

- Applies the poetics to computer-based **drama**
- Renames levels in attempt to meet demands of formal & material causes



# Mateas's "Preliminary Poetics" (2004)

- Adds Janet Murray's sense of user Agency, defined here as a balance of affordances and constraints



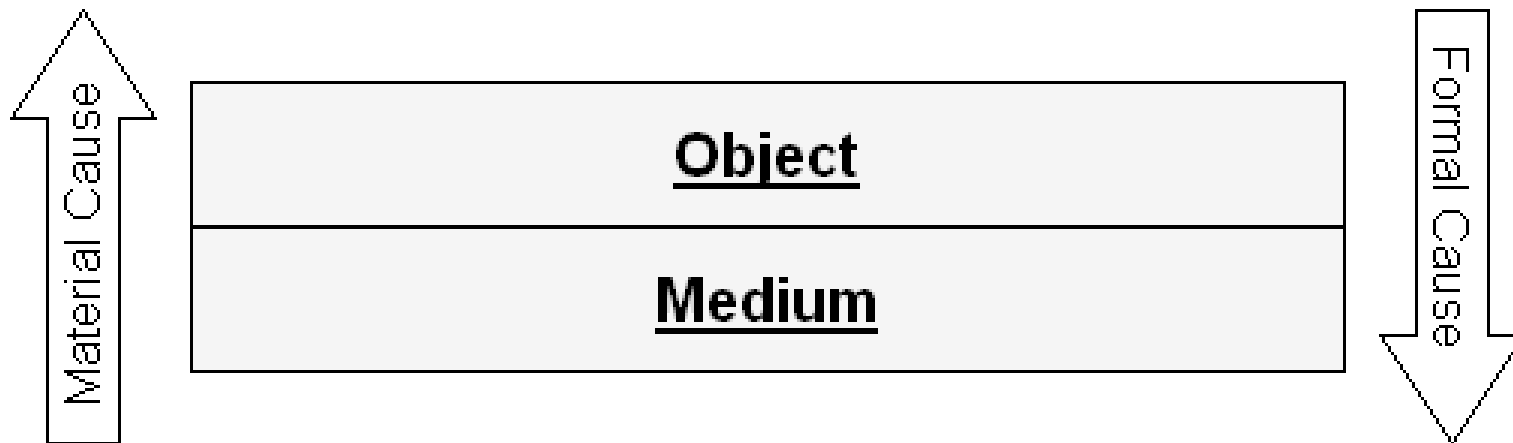


# Problems with Previous Poetics

- Loss of *manner*
- Very little distinction between *object* and *medium*
- Does not include drama world objects (props, setting, etc)
- Exclusivity of causal hierarchy, which requires constructions of a level only in terms of the level immediately below it, causes certain tensions (ie, characters *only* formed of thought, *all* language must convey thought)

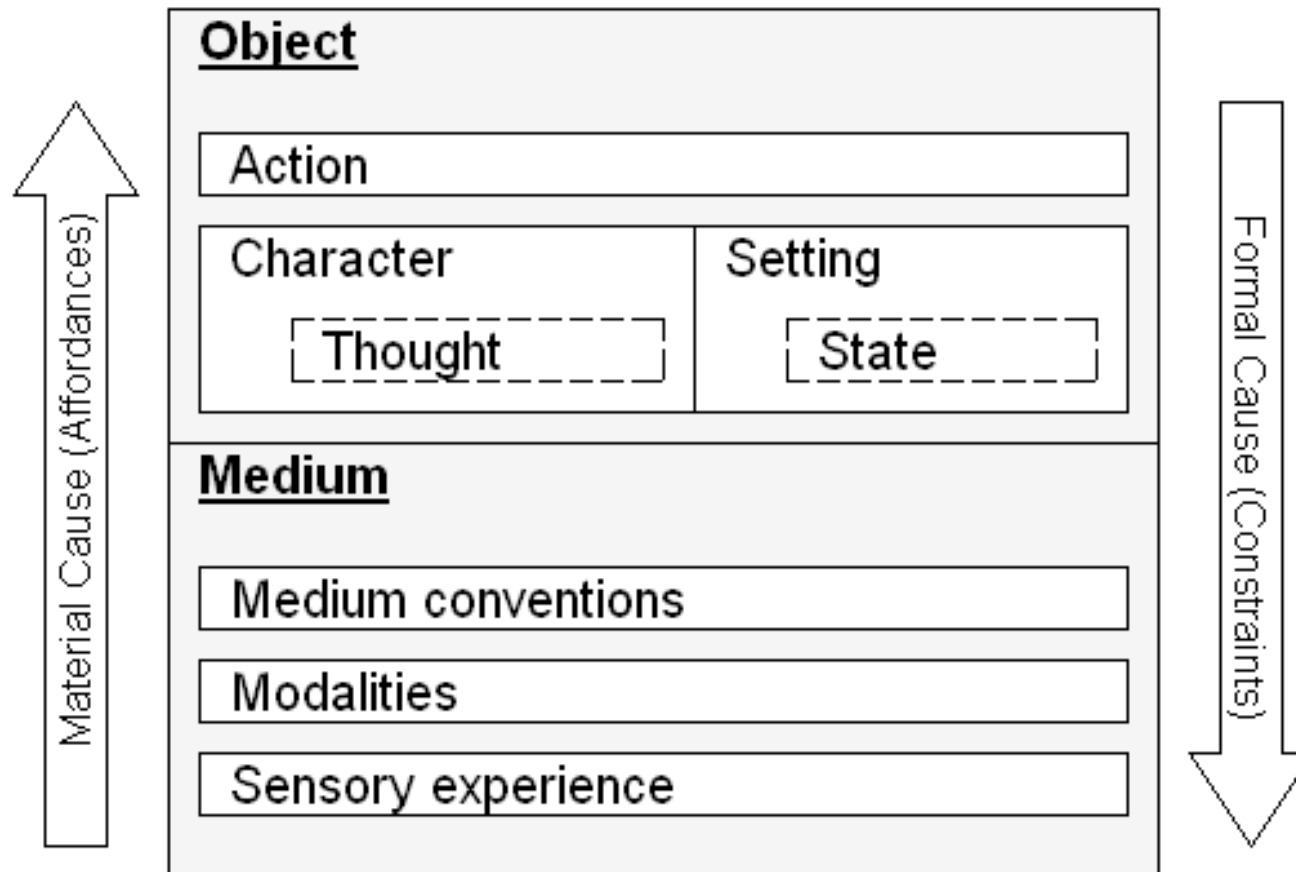
# Reformulation (1)

- Returned to distinction between object and medium



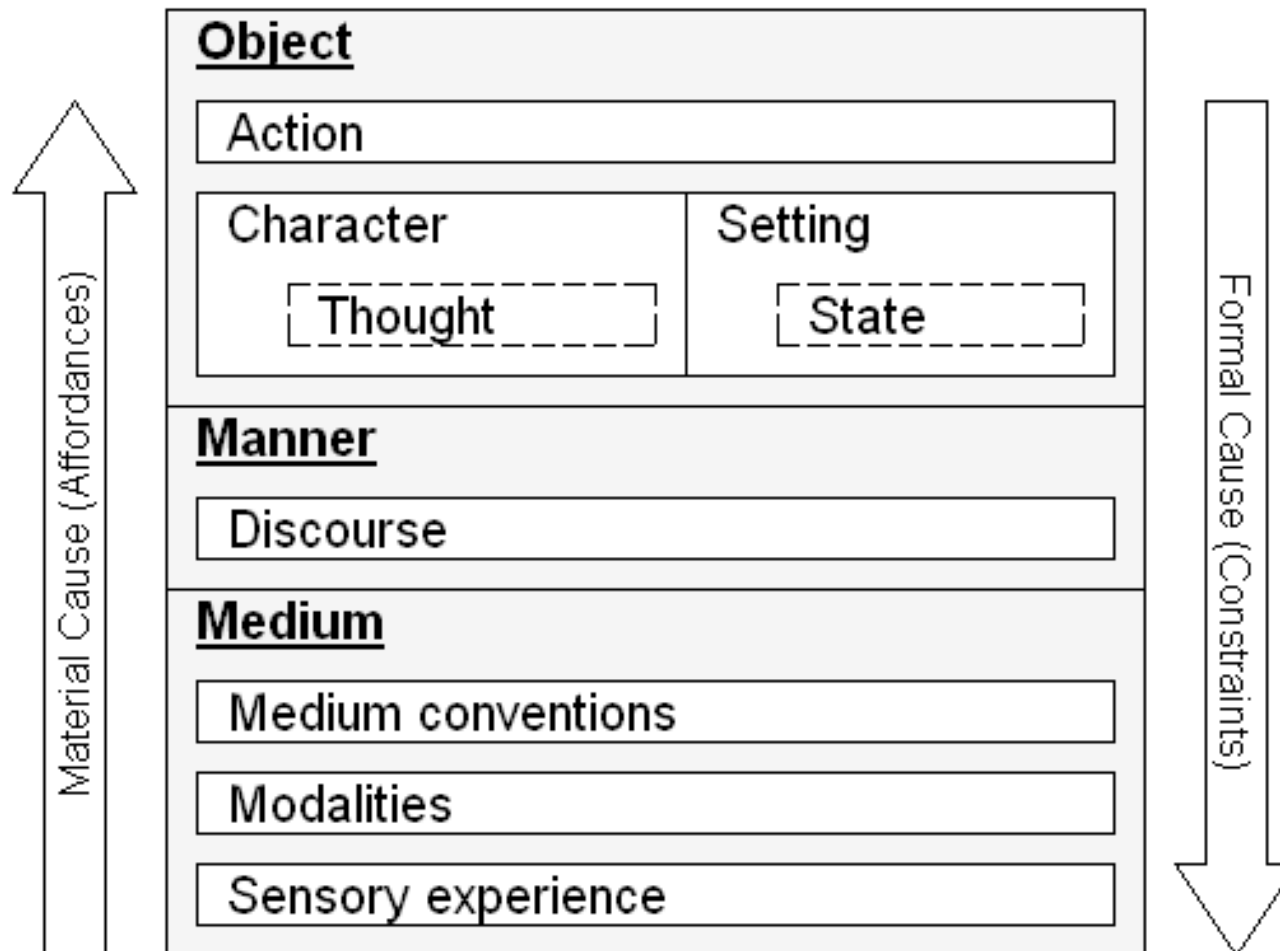
# Reformulation (2)

- Included most of the existing levels, but in a way that adheres to the causal requirements



# Reformulation (3)

- The return of *manner* to the model means it can apply to other forms of interactive narrative



# Benefits of this new poetics

- Includes most of the definitions of existing model
- Describes other forms of interactive narrative (depending on level at which user interaction occurs).
- Closely matches actual implementation architectures (*drama manager, characters, world environment, presentation interface*)
- Allows for discussion of medium-specific details

# **Tell Me More: Lessons from the Trenches**

# Implementation Lessons (very briefly)

Inform not the ideal game engine for this:

- Language (Inform) too simple and quirky
- Interactive fiction has poor affordances, especially for modern audiences. Not clear what actions are possible and which objects support interaction. Also requires spatial visualization of virtual world.
- Flexible/variable narration of scenes difficult to produce

# Implementation Lessons (very briefly) – 2

Scenes are too complicated:

- Externally simple: `canPlay` and then `play`
- Internally complex to produce runtime variations
- Managing characters and world-state from monolithic scenes is a headache
- Scenes need to be broken down into well-defined components



# Implementation Lessons (very briefly) – 3

NPCs need more work:

- Should always react immediately (similarly to objects) but still need to be coordinated by DM
- NPC internal state and state changes are not readily apparent because it is difficult to narrate gracefully. (Related to text-based affordances.)
- Should be individually authored rather than pulling from common store of responses (but that means more authoring)

# Implementation Lessons (very briefly) – 4

More than reincorporation should be considered when selecting scenes:

- Often required to respond to certain actions immediately
- Sometimes need to introduce new material to advance the story

# Implementation Lessons (very briefly) – 5

## Success:

- Stories are generated at run-time
- Very flexible potential combinations of scenes (does not use branching-tree structure; actually a bit of a burden on the author trying to test)
- In general, authoring burden is still very high, both in complexity and amount of material required. (Well-worn story paths, but fringe story cases still need to be covered.)
- More to a working interactive drama than just story structure/management.

# Tell Me More: Participant Backgrounds

# Results: Backgrounds

- Sent to lists: CIS, ICS, ACM; LIS, ITM, Engineering
- Gender: 15 men, 9 women
- Age:
  - 1 (45-54)
  - 5 (35-44)
  - 9 (25-34)
  - 9 (18-24)
- Education completed:
  - 4 – Phd
  - 5 – Grad school
  - 8 – University/College
  - 1 – Community College
  - 4 – Some college
  - 2 – Graduated High School

# Results: Computer Experience

- Feel comfortable using a computer: 3.79 / 4.0
- Hours of computer use per day: All  $\geq 3$  hours, majority  $\geq 6$ .
- Reading text on a screen: 22 fine, 2 tolerable, 0 avoid
- Command line interface: 22 had used one.

# Results: Digital Game Experience

- Average time spent on PC games:  
1+ hours/day, 11 don't play
- On non-PC games (console, hand-held, etc):  
< 1 hour /day; 8 don't play
- Average PC games played: 20 – 50
- Average non-PC games played: 20 - 50

# Results: Game Genre Familiarity Scale

Scale (4 to 0):

**4** - I have played a number of games in this genre

**3** - I have played at least one game in this genre for many hours

**2** - I have briefly played or watched someone else play a game like this

**1** - I know what this is, but I have never played one

**0** - I do not know what this is



# Results: Digital Game Familiarity

**2.08** – Interactive Fiction / Text Adventure

**2.38** – Adventure games

**3.08** – Computer or console RPGs

**1.13** – MUDs

**2.29** – MMORPGs

**2.58** – Social Simulations

**2.96** - First-person shooters

# Results: Non-Digital Game Familiarity

**2.54** – Branching novels and gamebooks

**2.13** – Table-top roleplaying games

**1.58** – Live-action roleplaying

**1.88** - Improv