

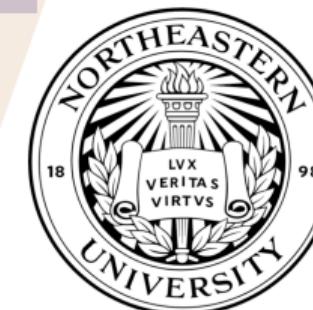


# Engagement or Distraction?

Examining the Impact of Narrative Elements and Player Audience  
on Experience of Logic Grid Puzzles

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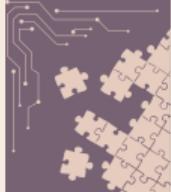
# Table of Contents

► Introduction

► Puzzle Design

► User Study

► Conclusion



## Motivation

- Many puzzle games incorporate narrative elements
- The depth of which players must engage with the narrative varies greatly
- We seek to examine how level of narrative interaction effect the puzzle solving experience



# Logic Grid Puzzles

|              |         | Puzzle  |         |         |         | Hints     |             |  |
|--------------|---------|---------|---------|---------|---------|-----------|-------------|--|
|              |         | subject | teacher |         |         |           |             |  |
| hour         | teacher | Math    | Science | English | History | Ms. Smith | Mr. Johnson |  |
|              |         | 1:00 PM |         |         |         |           |             |  |
|              |         | 2:00 PM |         |         |         |           |             |  |
|              |         | 3:00 PM |         |         |         |           |             |  |
|              |         | 4:00 PM |         |         |         |           |             |  |
| Ms. Smith    |         |         |         |         |         |           |             |  |
| Mr. Johnson  |         |         |         |         |         |           |             |  |
| Ms. McDonald |         |         |         |         |         |           |             |  |
| Mr. Baker    |         |         |         |         |         |           |             |  |

**Select Mark**

O  X  O  X

(click to cross out/uncross)

1. Science is taught at 2:00 PM
2. Mr. Baker's class is at 3:00 PM
3. English is taught at 4:00 PM
4. Either Ms. Smith's class is at 3:00 PM or History is taught by Ms. McDonald
5. The class at 2:00 PM is taught by Ms. Smith

[Check my Solution](#)  
[Clear Solution](#)  
[Exit to Survey](#)



# Logic Grid Puzzles

|              |         | Puzzle  |         |         |         | Hints     |             |                              |           |  |  |                                    |  |  |  |
|--------------|---------|---------|---------|---------|---------|-----------|-------------|------------------------------|-----------|--|--|------------------------------------|--|--|--|
|              |         | subject | teacher |         |         |           |             | (click to cross out/uncross) |           |  |  |                                    |  |  |  |
| hour         | teacher | Math    | Science | English | History | Ms. Smith | Mr. Johnson | Ms. McDonald                 | Mr. Baker |  |  |                                    |  |  |  |
|              |         | 1:00 PM |         | X       |         |           |             |                              |           |  |  |                                    |  |  |  |
|              |         | 2:00 PM | X       | O       | X       | X         |             |                              |           |  |  | 1. Science is taught at 2:00 PM    |  |  |  |
|              |         | 3:00 PM |         | X       |         |           |             |                              |           |  |  | 2. Mr. Baker's class is at 3:00 PM |  |  |  |
|              |         | 4:00 PM |         | X       |         |           |             |                              |           |  |  | 3. English is taught at 4:00 PM    |  |  |  |
| Ms. Smith    |         |         |         |         |         |           |             |                              |           | 4. Either Ms. Smith's class is at 3:00 PM or History is taught by Ms. McDonald |  |                                    |  |  |  |
| Mr. Johnson  |         |         |         |         |         |           |             |                              |           | 5. The class at 2:00 PM is taught by Ms. Smith                                 |  |                                    |  |  |  |
| Ms. McDonald |         |         |         |         |         |           |             |                              |           |  |  |                                    |  |  |  |
| Mr. Baker    |         |         |         |         |         |           |             |                              |           |  |  |                                    |  |  |  |

**Select Mark**

O  X  O X



# Logic Grid Puzzles

**Puzzle**

|              | subject | teacher |         |         |           |             |              |           |
|--------------|---------|---------|---------|---------|-----------|-------------|--------------|-----------|
|              | Math    | Science | English | History | Ms. Smith | Mr. Johnson | Ms. McDonald | Mr. Baker |
| hour         | X X X O | X X O X |         |         |           |             |              |           |
|              | X O X X | O X X X |         |         |           |             |              |           |
| 2:00 PM      | X O X X | O X X X |         |         |           |             |              |           |
| 3:00 PM      | O X X X | X X X X |         |         |           |             |              |           |
| 4:00 PM      | X X O X | X O X X |         |         |           |             |              |           |
| teacher      |         |         |         |         |           |             |              |           |
| Ms. Smith    | X O X X |         |         |         |           |             |              |           |
| Mr. Johnson  | X X O X |         |         |         |           |             |              |           |
| Ms. McDonald | X X X O |         |         |         |           |             |              |           |
| Mr. Baker    | O X X X |         |         |         |           |             |              |           |

**Hints**  
(click to cross out/uncross)

1. Science is taught at 2:00 PM
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**Select Mark**

|                          |   |   |   |   |
|--------------------------|---|---|---|---|
| <input type="checkbox"/> | O | X | O | X |
|--------------------------|---|---|---|---|



## Abstract

- We designed various levels of narrative interaction on top of logic grid puzzles
- We tested the effect of these different modes on two populations:
  - Paid users from the Prolific Website
  - Volunteers from puzzle and interactive fiction groups
- Volunteers found the puzzles easier but enjoyed them less
- All groups found more narrative interaction harder, but had mixed views of enjoyment



# Table of Contents

► Introduction

► Puzzle Design

► User Study

► Conclusion



## Step 1: Puzzle Generation

**Puzzle**

|                 | car          |          | suspect  |
|-----------------|--------------|----------|--|
| station         | Greenchester | Seastead | Ethan Owen<br>Madeleine Baker<br>George Herbert<br>Ava Finch |
| suspect         | Greenchester | Seastead | Hogfield   |
|                 | Forest Hills |          |  |
| Ethan Owen      |              |          |  |
| Madeleine Baker |              |          |  |
| George Herbert  |              |          |  |
| Ava Finch       |              |          |  |

**Select Mark**

|                          |                                     |                          |                          |
|--------------------------|-------------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|-------------------------------------|--------------------------|--------------------------|

- The station Forest Hills is the passenger Madeleine Baker
- The passenger George Herbert is the station Hogfield
- The station Forest Hill is 1 car before the station Seastead
- The passenger Ethan Owens is 2 cars before the station Greenchester

Figure: Puzzle Grid



## Step 2: Base Puzzle Design

### The Wild Rose Train

Your 3-month long expedition to the city of Watertown has finally paid off, your research has led to a new medicinal herb that is bound to lead to academic and financial success. All you need to do is travel back to Riverside, to deliver the news to your PhD advisor. With your discovery tucked safely in your briefcase, you take a late night journey on the Wild Rose Train. After a well-deserved night of rest, you wake up to find your briefcase, along with your groundbreaking discoveries, missing!

Frantic, you tell the conductor Jim Gallagher. He conducts a thorough search of the train, but unfortunately the briefcase is not to be found. One of the other passengers must have taken it from your room and departed with it early this morning. Jim informs you that there were four other passengers on this train, all of whom got on before you and have already departed: Sir Ethan Owen, Ms. Madeleine Baker, Mr. George Herbert, and Dr. Ava Finch. Each was located in a different car of the train, and departed from a different station. Unfortunately the record of where each passenger's room was and where they left the train is also missing. If you can figure out where each passenger was located, and where they got off you will be one step closer to retrieving your precious briefcase.

### Clues

1. The person who departed at Forest Hills Station was Madeleine Baker
2. George Herbert departed at Hogfield Station
3. The person who left at Forest Hills was 1 car before the person who left at Seastead
4. Ethan Owen was located 2 cars before the person who departed at Greencester



## Step 3: Paragraph Design

**The Wild Rose Train**

Story Clue 1 Clue 2 Clue 3 Clue 4

A witness statement from Chef May Gardner

"Madeleine was the first to arrive in the dining car for breakfast. She didn't eat much but claimed she wanted to make sure she got the first brew of coffee. While sipping on her coffee I noticed her sketching something in her journal. It was a flower, a mysterious-looking thing with strange spindly petals. I am not much of a botanist myself, but I have never seen anything of the sort before. I asked what kind of plant that was, and she told me it didn't exist .... yet. Apparently she had this vision of a flower that would be a cross of a Lily only found in Forest Hills with one of her personal breeds. Personally, I think nature has provided us with more than enough flowers without all this fiddling."



## Step 4: Interactive Fiction Design

sleep last night. The only way the briefcase is no longer on the train, is if one of the other passengers came into your room and took it! You must find out which passenger took it and where they got off before it's too late!

Unfortunately, you don't know where each passenger got off or even what car they stayed in last night. If you can figure out what station each passenger deboarded and what car they stayed in, you will be one step closer to your briefcase. You should talk more with the staff and see if you can gather any more clues from them!

### *Corridor*

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### *Dining Car*

In the dining car, still smells like bacon. The chef May Gardner is here.

"Honestly not surprised one of these passengers was a thief, there was something off about all of them you could tell. Not sure how much help I can be; I spent the morning in the dining car. But I will tell you what I do know."

- »Tell me about Sir Ethan Owen
- »Tell me about Ms. Madeleine Baker
- »Tell me about Mr. George Herbert
- »Tell me about Dr. Ava Finch
- »What was served for breakfast this morning?
- »Move to another part of the train

Figure: Caption



## Designed Scenarios

### **The Wild Rose Train**

A PhD Student loses their research on a train and has to find which passenger stole it

### **Lady Rose Ellington's Chrysanthemum Ball**

A necklace is stolen during a ball and the player must determine who danced which dance to find the thief

### **The Great Chili Competition**

The player must figure out their aunt's secret chili recipe to win this year's competition



# Table of Contents

► Introduction

► Puzzle Design

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## Study Design

- Puzzles
  - Primer: baseline puzzle
  - Experimental: Puzzles in the three interaction modes
- Recruiting populations
  - Prolific users: 142 crowd-workers paid \$2.50 per puzzle
  - Volunteers: 34 people recruited from related social media, not paid for their time



## Measures

- Behavioral measures
  - Time Spent
  - Number of attempts
  - Percent of incorrect marks
  - Percent incomplete
  - Correctness
- Subjective
  - Difficulty: Cognitive subsection of the Video Game Demand Scale
  - Enjoyment: Engagement subsection of the Game User Satisfaction scale
  - Narrative: Narrative subsection of the Game User Satisfaction scale
  - Open text responses



# Effect of recruiting population: Challenge

Ranked based correlation: Spearman

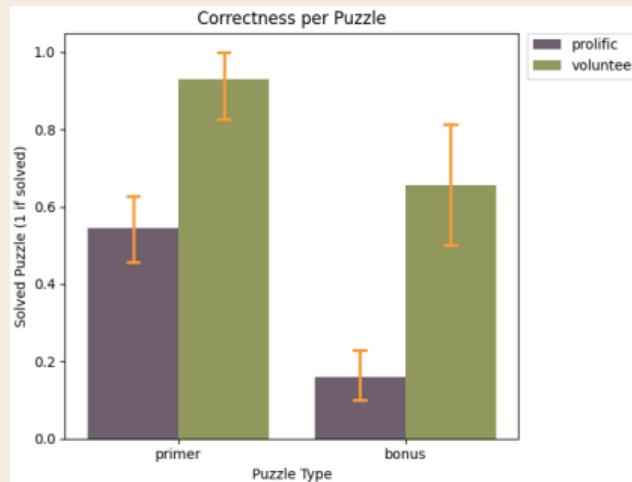


Figure: Percent of solved puzzles by population

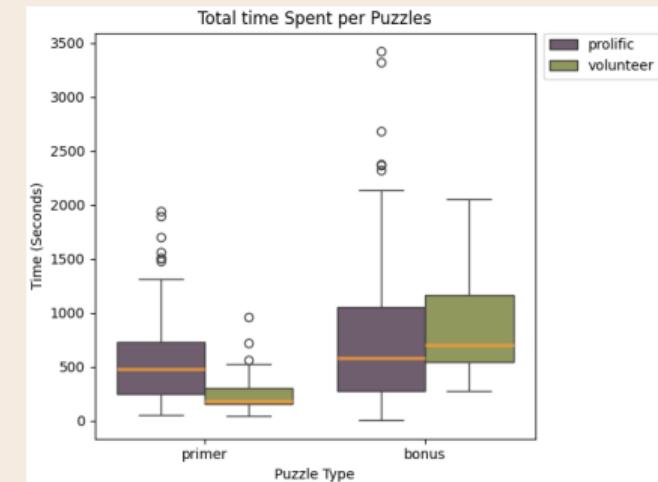


Figure: Time spend by population



# Effect of recruiting population: Enjoyment

Ranked based correlation: Spearman

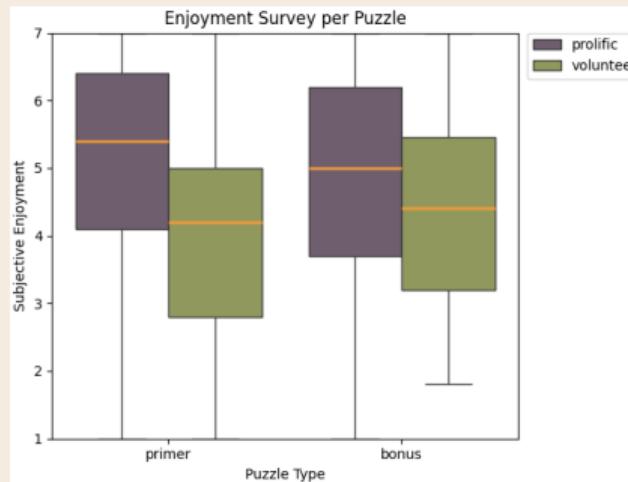


Figure: Engagement in puzzles by population

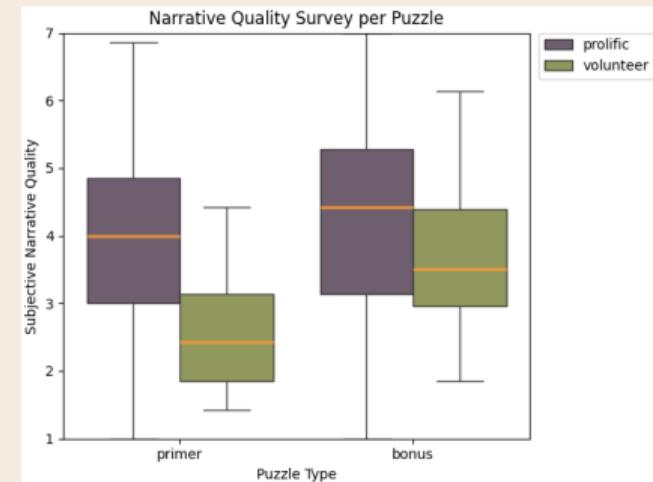


Figure: Narrative Quality by Population



## Effect of recruiting population: Open Text Responses

### Prolific Users

- Left comments about 40% of the time
- Average word length of 6
- Left several single word and rude comments
- Were more likely to comment that the puzzles were hard

### Volunteers

- Left comments about 40% of the time
- Average word length of 24
- Left no rude comments
- Were more likely to comment that the puzzles were easy



# Effect of Narrative Mode: Prolific Users

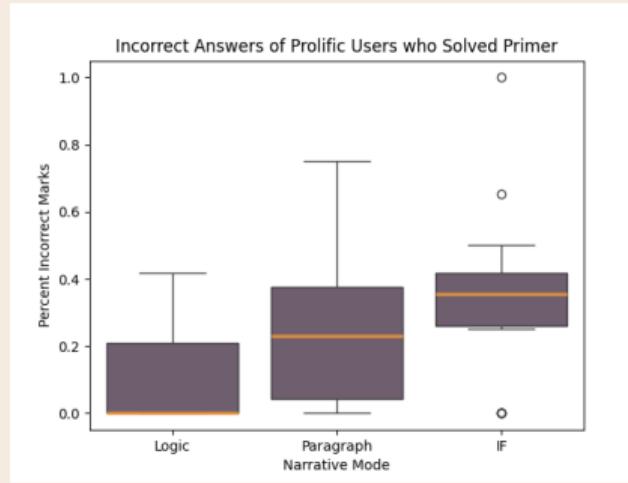


Figure: Percent incorrect marks puzzles by narrative mode

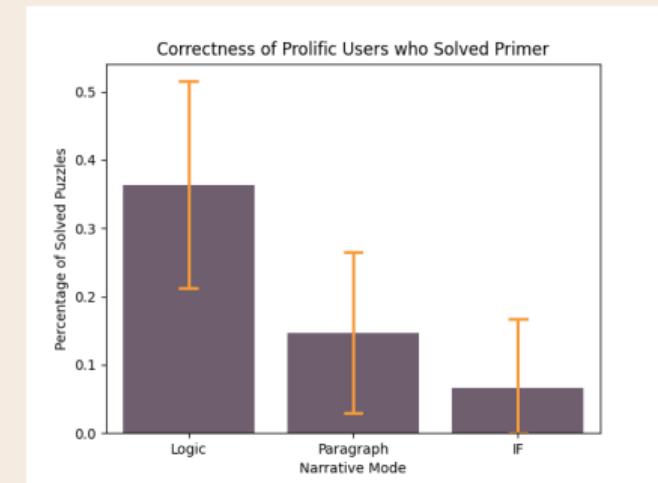


Figure: Correctness of puzzles by solver loops



# Effect of Narrative Mode: Volunteers

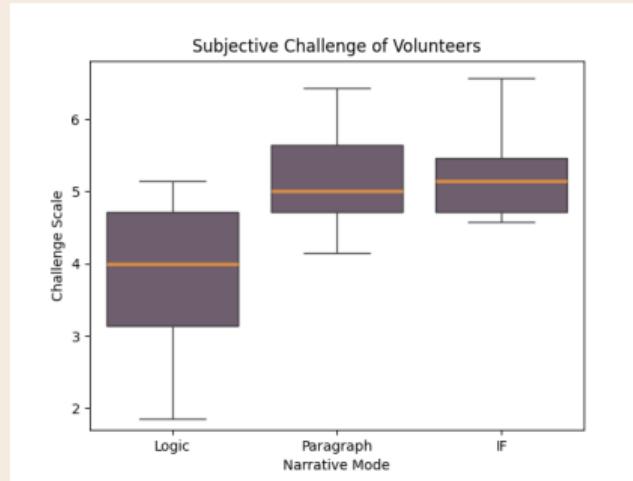


Figure: Subjective Difficulty of puzzles narrative mode

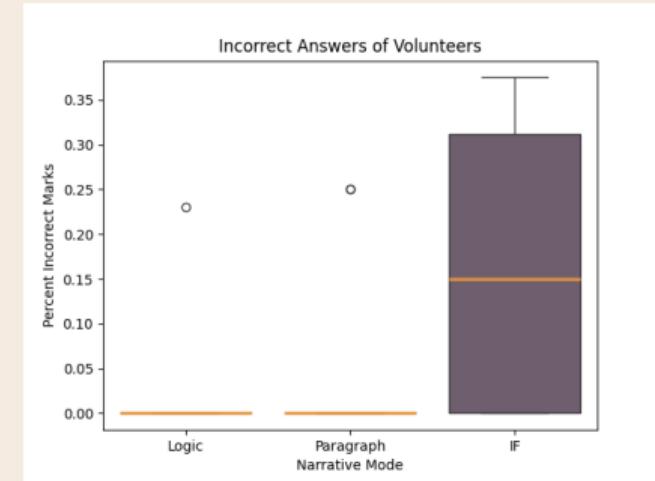
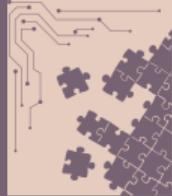


Figure: Percent incorrect marks by narrative mode



## Qualitative Results

- Some participants enjoyed the narrative format  
*“[It was] like reading [the story] in real time.”*
- An equal number were frustrated  
*“The fun aspect of the puzzle was lost trying to go through and make sure you read everyone’s statement.”*



# Table of Contents

► Introduction

► Puzzle Design

► User Study

► Conclusion



## Main outcomes

- We designed puzzles with the same base puzzle in increasing amount of narrative
- The increase of narrative made the puzzles harder and had a varied impact on enjoyment
- Volunteer participants found the puzzles easier but enjoyed them less



## Future Work

- Creating guidelines for generative narrative systems
- Examining how to incorporate narrative without increasing difficulty
- Exploring adaptive narrative modes based on preference



## End of Presentation

### Play the Puzzles



[https://  
//logic-puzzles-debug.web.app/](https:////logic-puzzles-debug.web.app/)

### OSF Project



<https://osf.io/kg4qs>