

# MKULTRA (Demo)

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## Abstract

*MKULTRA* is an experimental game that explores novel AI-based game mechanics. Similar in some ways to text-based interactive fiction, the player controls a character who interacts with other characters through dialog. Unlike traditional IF, *MKULTRA* characters have simple natural language understanding and generation capabilities, sufficient to answer questions and carry out simple tasks. The game explores a novel game mechanic, belief injection, in which players can manipulate the behavior of NPCs by injecting false beliefs into their knowledge bases. This allows for an unusual form of puzzle-based gameplay, in which the player must understand the beliefs and motivational structure of the characters well enough to understand what beliefs to inject.

## Introduction

Although there has been a great deal of interesting research on both classical AI (in the sense of symbolic reasoning and representation) and game AI, there are surprisingly few examples of playable games that foreground symbolic reasoning systems in their NPCs.

This is partly because common genres have evolved not to require AI. The conventions of table-top RPGs such as *Dungeons and Dragons* or *Fiasco* differ so much from those of video game RPGs such as the *Final Fantasy* series in part because the latter developed in a context where NPCs had to be fully scripted, whereas TTRPGs have human game masters to play NPCs. Jacopin (2014) found that although most high end first-person shooters currently use some form of propositional planning system, characters rarely generate plans of more than one or two actions because the environment changes so rapidly, it doesn't make sense to plan farther than that into the future.

This suggests there is an opportunity to design new game genres and mechanics that directly leverage the strengths of, and mitigate the weaknesses of, classical AI systems. By co-designing mechanics with the game AI

itself, we can create fundamentally new modes of gameplay.

*MKULTRA* is an experimental game that explores the use of NPCs with generative reasoning and natural language capabilities. The player acts as the interior voice of the player character, suggesting goals and actions to her through typed natural language. The player character then interacts through dialog with NPCs possessing the same capabilities. Characters have generative natural language capabilities on the order of a high-end 1980s Prolog program. The natural language system is based on definite clause grammars and Chat-80-style (Warren & Pereira, 1982) question answering, and the problem solver is based on Sibun's Salix system (1992), which was in turn based on McDermott's NASL (1978).

## Genre

*MKULTRA* is a mystery-and-detection game where the player-character seeks to find the secrets behind a shadowy conspiracy. The choice of genre is important because it gives the player a reason to interact through natural language dialog.

Although ultimately a tile-based RPG in the style of games such as *EarthBound* (Itoi, 1994), *MKULTRA*'s gameplay is more similar to parser-based interactive fiction such as *Deadline* (Blank, 1982) in that the player controls their character through typed natural language. However, unlike parser-based IF, all characters, both PC and NPC, are autonomous AI systems. The player can therefore give more complex commands and questions to the characters (e.g. "search the house" rather than "examine the coffee pot"), and characters can refuse requests for non-scripted reasons.

For example, if you tell a character to eat another character, it will reply “that would be immoral” on the grounds that the action would result in the death of a character who was previously living, and the action was not self-defense. If on the other hand, you can convince the character that eating the other character would not be murder (see below), then they will do it.

## Game Mechanics

MKULTRA involves two novel game mechanics: belief injection, and the sonification of NPC reasoning processes. These both allow for new kinds of puzzle-based gameplay.

### Belief injection

The game allows the player to place false beliefs directly in the knowledge bases of NPCs, thereby changing their behavior. This creates a puzzle for the player to understand enough about the reasoning processes of the character to know what belief(s) to inject such that the character will perform the desired actions.

For example, in the demo level, the player attempts to find an item stolen by an NPC who is a member of the Bavarian Illuminati. The NPC will not divulge the location of the item to characters who are not themselves members of the Illuminati, and so will lie when questioned about it. The player can solve the problem by injecting any number of the beliefs into the mind of the NPC, such as:

- The player character is also member of the illuminati. The NPC will then happily divulge the location of the object.
- The player character is absent. The NPC will then ignore the fact that the PC is obviously searching the house
- The NPC is an orange and is also very hungry. The NPC will obligingly commit suicide through auto-cannibalism, thereby freeing the PC to inspect the house.

### AI sonification

One of the important open problems in game AI involves how to communicate the internal state of an AI system to the player. As an experiment in this direction, MKULTRA includes a sound synthesizer that is driven by a log of the activity of an NPC’s problem solver, thereby allowing the player to “hear the character think” in real time.

The synthesizer uses granular synthesis (Roads, 1996), using FM synthesis for the grains (Chowning, 1973). Each time the character’s AI system performs an important operation, such as considering a goal reduction, choosing between alternate goal reductions, or deciding whether to lie, it plays a short (3-7ms) “grain” of sound whose spectrum depends on the type of event.



Figure 1 Screenshot from the game

At the moment, this mechanic has not been extensively explored. It allows the player to know how hard the character is thinking (based on how much audio is generated), and in extreme cases what they are thinking (if they can learn to recognize the sound of the character lying). But one of the goals of the system is modulate the timbre of the sound based on the character’s affective state and their intentions toward the player character.

## Implementation status

The game is currently a tech demo, since the only gameplay is a demo level. The system built in Unity (Unity Technologies, 2004). The AI code is written in a homebrew dialect of Prolog. The AI engine is feature complete; it includes natural language parsing and generation, question answering, dialog, problem solving, and in-engine debugging tools. The system also includes a simple beat sequencer patterned loosely on *Façade* (Mateas & Stern, 2005) and quip manager based on the work of Short and Evans (2014).

The system has also been used in an upper division undergraduate course on character AI in which students worked with the *MKULTRA* codebase. Student projects with the codebase were limited, but because of the amount of time required to cover introductory material, particularly

Prolog programming, but students were able to use it to make simple question-answering applications, and to modify the grammar. In addition, a number of the students asked if a follow-on course could be taught, which is encouraging.

## Conclusion

MKULTRA is an experiment in designing novel AI-centric gameplay. Although still a work in progress, our hope is that by designing new mechanics and genres around the capabilities (and limitations) of AI systems, that we will be able to explore fundamentally new modes of gameplay.

Another goal of the system is for it to be usable as a base for game AI and interactive narrative researchers to start from when implementing new systems. It's impractical for most Ph.D. students to begin their dissertations by implementing the infrastructure required for a game like *MKULTRA* or *Façade*. By making *MKULTRA* open-source and teaching a class with it, I hope to put it in a condition whereby it would be practical for researchers wishing to work on drama management, for example, to start from a working system and focus on implementing the functionality important for their research, rather than writing tile editors or parser-generators.

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