

# LUCID LOOP

## A Virtual Deep Learning Biofeedback System for Lucid Dreaming Practice



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### Introduction

**Lucid dreaming** is awareness that you are dreaming while asleep. The dreamer is then able to take control of the dream to experience virtually anything, including flying, confronting a fear, or exploring their own consciousness.

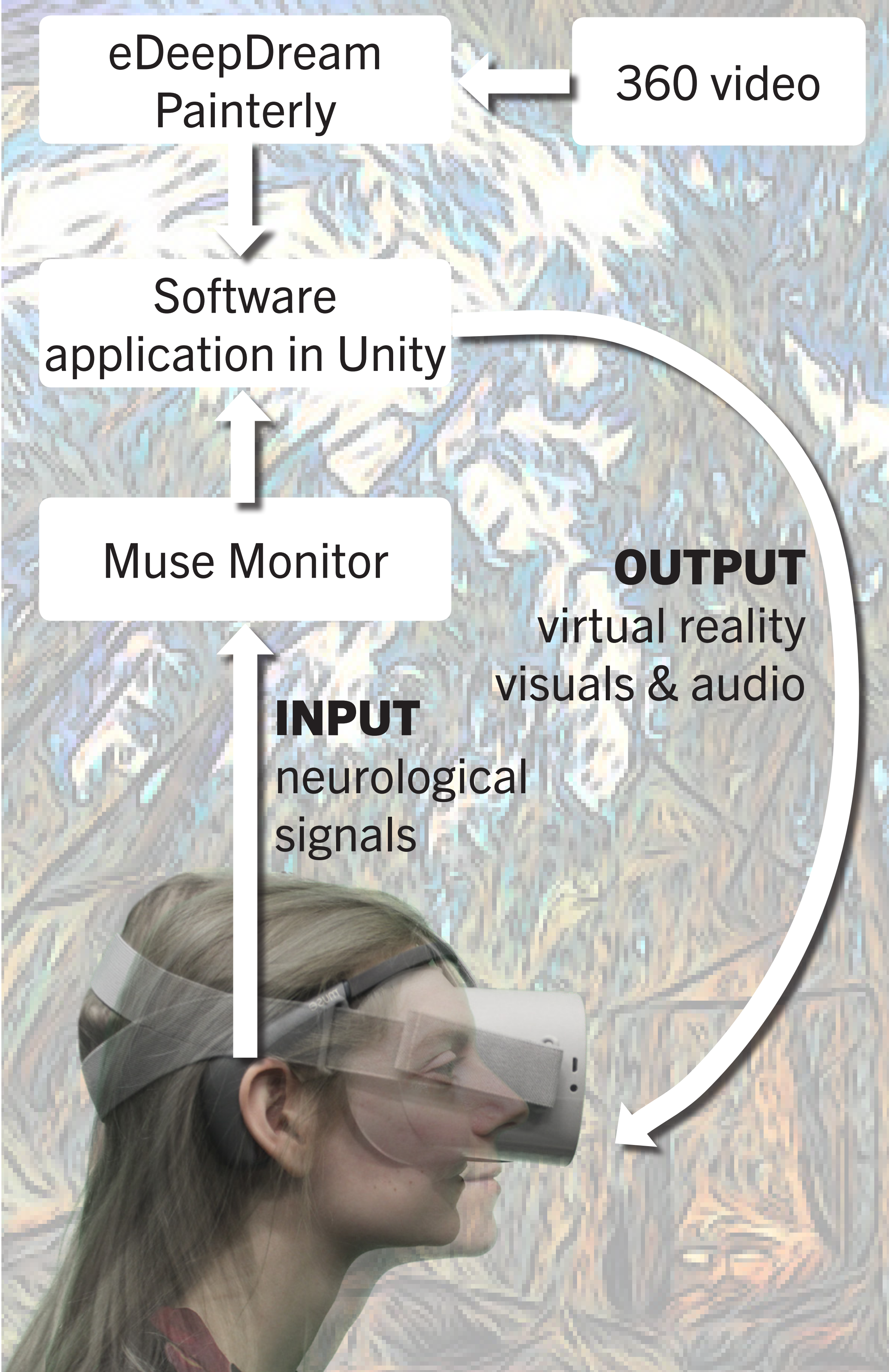
Learning to lucid dream takes time and practice, and not everyone is convinced by, nor successful with, traditional techniques and tools that primarily use written and audio guides. Two of the primary ways to learn lucid dreaming is by **rehearsing and visualizing** becoming lucid, and controlling one's **attention**.

Can we support lucid dreaming **rehearsal and visualization** through an **immersive virtual reality** experience based on phenomenological reports of lucid dreaming?

Can **focused awareness (attention)** be learned through **neurofeedback** of one's mental state?

**Aim:** to explore technology as a means to support lucid dreaming through practicing focused awareness and visualization

### Lucid Loop Schematic



### System Description

#### Visual Design

lucid dreams are **colourful, vivid, and bright** compared to nonlucid dreams; **bizarreness** is needed for dreaming awareness, but once achieved, the dream scene is relatively **realistic**

Lucid Loop visuals become **more realistic** and **less bizarre** as lucidity increases



Original 360 video still



Deep Dream



Painterly

#### Machine Learning and Art

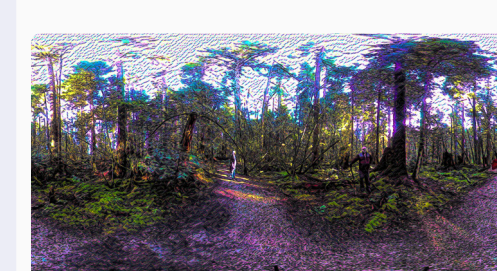
**Enhanced Deep Dream**, originally developed by Google, but enhanced by DiPaola, McCaig to understand and output art based imagery. The system trained on our art database uses a guide image that then biases toward ('hallucinates') a 2nd guide image creating a dream-like quality.

**Painterly**, developed by DiPaola, is a nonphotorealistic rendering system that uses algorithmic, particle system, and noise modules to generate artistic colour palettes, stroking and styles.

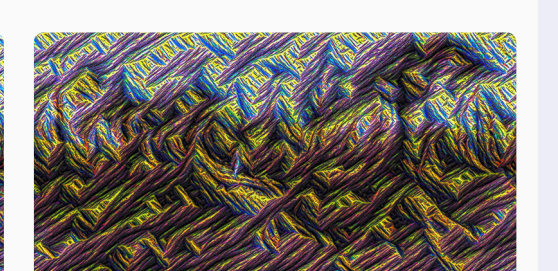
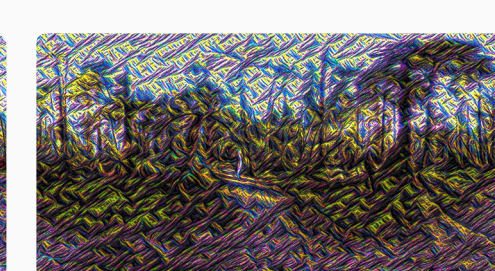
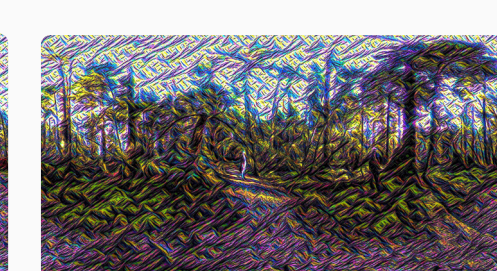
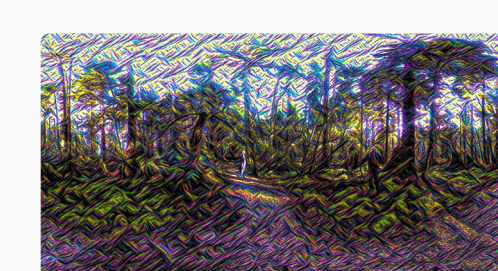
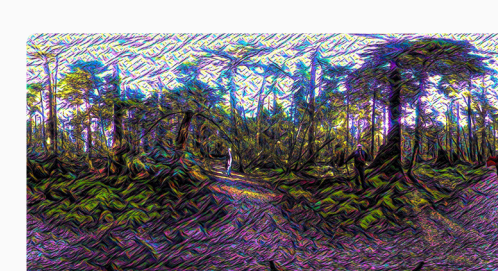
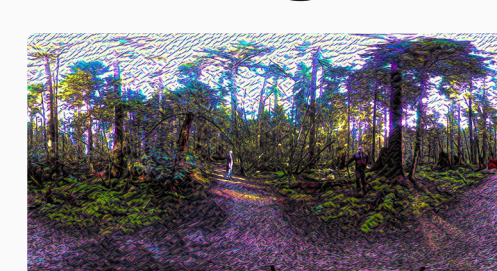
Lucid Loop uses **360 video** whose frames are run offline through **eDeepDream** and **Painterly** seven times to create seven layers of video. The 360 video is then rendered in a **virtual reality** headset with **Unity**, a 3D game development platform, where **neurological signal** data from the Muse 2 headset changes the layers in realtime.

#### Biofeedback Mapping

gamma waves (30-50Hz) & beta waves (13-30Hz)



level 1



level 7

0 unfocused awareness

bizarre imagery, whispers

1 focused awareness

realistic imagery, clear, loud voice

### Future Studies and Implications

#### Phase 1

##### Test and Validate Components

- EEG data for focused awareness
- interaction mapping from EEG to visual and auditory components
- user experience with proficient and experienced lucid dreamers
- virtual reality as medium for lucid dreaming visualization

#### Phase 2

##### Mixed Methods Evaluation

- measure physiological signals from brain waves (EEG)
- conduct qualitative participant experience interviews
- record questionnaire responses
- triangulate data to validate participants' experience of lucidity

**Lucid Loop** has the potential to be a powerful new tool for research into lucid dreaming and its practices, whose benefits may contribute to wellbeing. Direct feedback to playfully support awareness of one's state may ultimately help to self-regulate one's state and enable more frequent and sustained lucid dreams.

More at CHI 2019  
**SIG: Transformative Experience Design**  
Wednesday 14:00 to 15:20  
**Interactivity Hot Desk**  
Wednesday 15:20 to 16:00  
Thursday 10:20 to 11:00

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**Ivan Aguilar** virtual reality consultant

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