

# PsyForge – Easy, Modern, Real-time, 2D/3D Experiment Design

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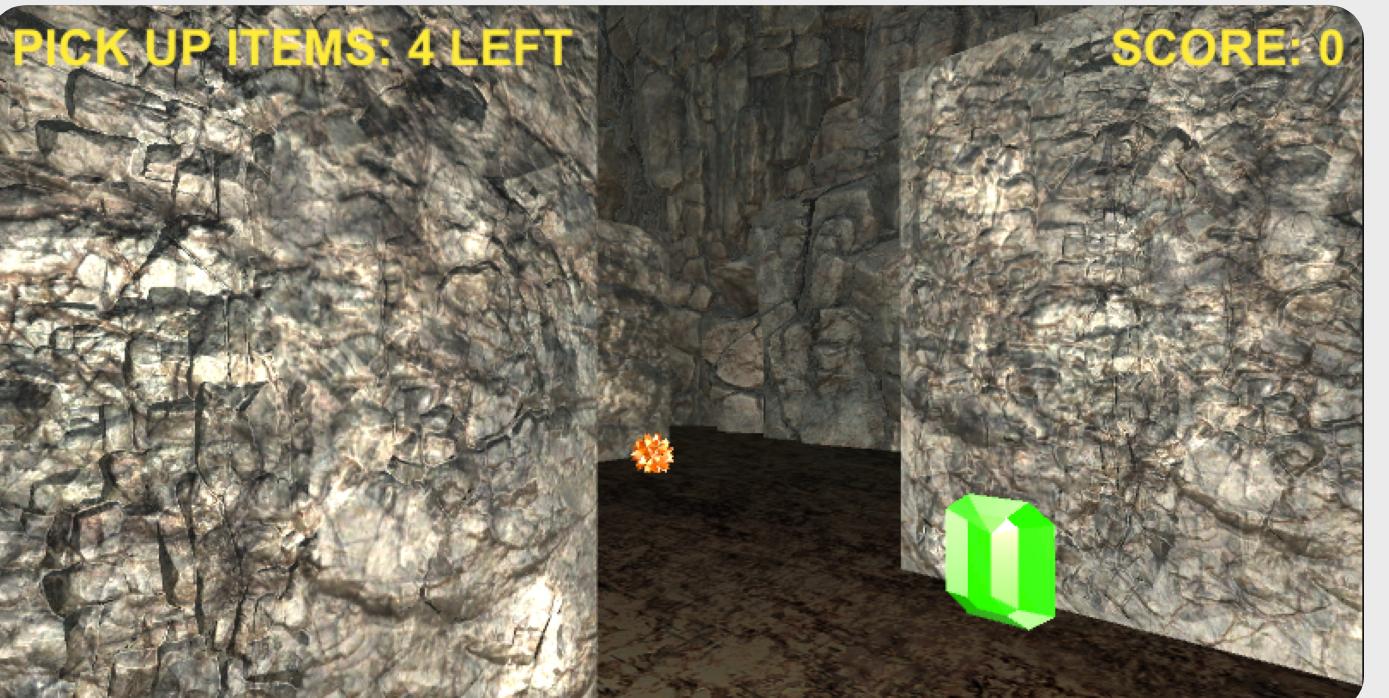
Tech Solutions for  
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## Limitations of Comparable Experiment Programming Libraries

- They only use 1 of the 8-32 compute cores in modern computers.
- Lack of prebuilt 3D game components.
- Standard Unity cannot reliably support closed-loop systems due to its design.
- Many lack <1ms event reaction time.
- We use threaded event loops to utilize all cores, react with sub-ms precision, and enable reliable closed-loop experiments. We also provide many prebuilt game components for 2D & 3D experiments.

## Example Experiment

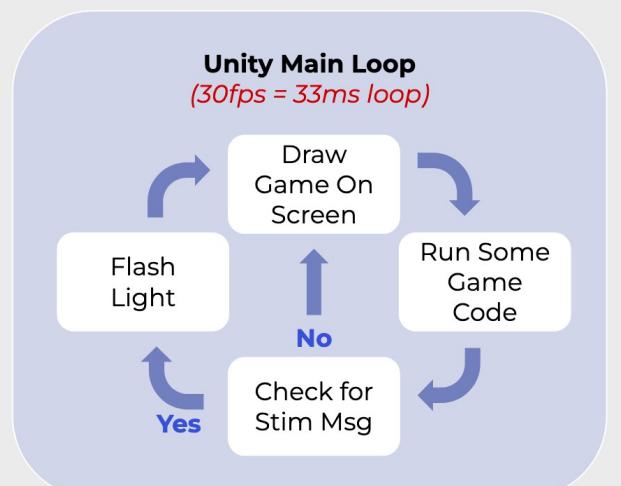


## Safe Threads Facilitate Closed-Loop Stimulation

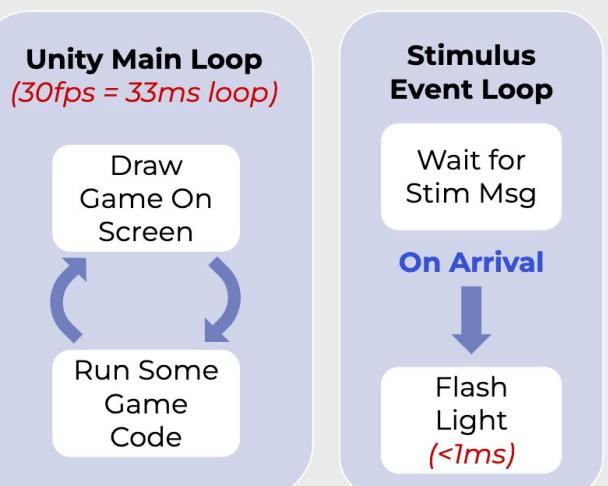
**Closed-loop systems are infeasible in standard Unity due to variable frame rates in a single loop.**

Imagine trying to flash an external light when EEG is in the positive rising portion (25%) of a 12Hz alpha wave.

### Standard Unity



### PsyForge



Standard Unity at 30fps (33ms)? — **NO** — 25% of 12Hz is 20ms.  
Standard Unity at 60fps (17ms)? — **MAYBE** — Frame rate can vary.  
PsyForge threads, for any fps? — **YES** — Sub-ms.

## References

Peirce, Journal of Neuroscience Methods, 2007; de Leeuw, Behavior Research Methods, 2015; Stoet, Behavior Research Methods, 2016; Geller et al., Behavior Research Methods, 2007; Solway et al., Behavior Research Methods, 2013; Del Grosso et al., Behavior Research Methods, 2019; Vasser et al., BMC Psychology, 2017; Brookes et al., Behavior Research Methods, 2020

## Experiment Programming Library Comparison

	PsyForge	UXF 2.0	PandaEPL	jsPsych	PsychoPy
Language	C# / Unity	C# / Unity	Python	JavaScript	Python
2D Support	✓	✓	✓	✓	✓
3D Support	✓	✓	✓	✓	
Cross-Platform	Desktop, Mobile, Online, & VR	Desktop, Mobile, Online, & VR	Desktop	Desktop & Online	Desktop & Online
Easy & Safe Multi-Threading	✓				
Closed-Loop Support	✓				~
Logging	✓	✓	✓	✓	✓
Experiment Startup Screen	✓	✓	✓		
Prebuilt Game Components	✓			✓	✓

Prebuilt Game Components: Language switching, EEG alignment, Experiment launch screen, Word presentation system, Config system, Math distractor, Questionnaire, etc.

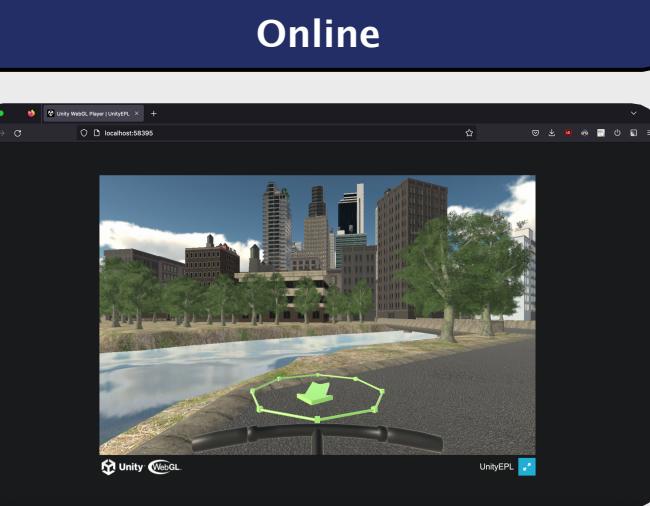
## Cross-Platform Releases

Unity can easily deploy to desktop, mobile, online, and even virtual reality headsets.

### Mobile



### Online



Online game on MTurk/Prolific

## Conclusions

- Ability to create 2D and 3D closed-loop experiments.
- Sub-millisecond reaction time to events.
- Useful prebuilt game components for 2D and 3D experiment creation.
- Easily deployable to desktop, mobile, online, and VR.
- All the benefits of the Unity ecosystem.
- Open-source (GPLv3) & extendable.

<https://github.com/BruskaTech/PsyForge>

```
protected async Task ClosedLoopVideo() {
    await manager.videoControl.SelectVideoFile(Config.dataPath, fileExtensions);
    await manager.textDisplayer.PressAnyKey("Start Video", "Press a button to play the video");
    await manager.lightController.StartClosedLoop(manager.videoControl.videoLength);
    await manager.videoControl.PlayVideo();
    var loggingMsg = new Dictionary<string, object> { { "length", manager.videoControl.videoLength } };
    manager.eventReporter.ReportScriptedEvent("Video Info", loggingMsg);
}
```