HRIStudio

Collaborative and Reproducible HRI Research Through a Web-Based
Wizard-of-Oz Platform

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The Wizard-of-Oz Experimental Method

Challenges

- Environment set up (cameras and microphones) and operation

- Supporting the control of different kinds robots

- Organizing assets generated (consent forms, video and audio captured) keeping in data confidentiality in mind that is appropriate to each role

- Executing faithfully the experimental script that governs the interactions between human subject and robot

- Issuing the same sequence of commands to the robot through every trial of the experiment and recording any deviations in the script that the wizard may introduce

Alternatives for WoZ Framework Development

Technical infrastructure and architectures

- Polonius (Lu and Smart, 2011): graphical wizard interface to define FSM robot behaviors; ROS-based; integrated experimental logging system; accessible to non-programmers

- OpenWoZ (Hoffman, 2016): configurable; multi-client architecture; robot behaviors modifiable in experiment; allows for multiple collaborators

Alternatives for WoZ Framework Development

Interface design and user experience

- NottReal (Percheron, Fischer, and Valstar, 2020): careful interface design; wizard actions made easy; customization features; comprehensive logging

- WoZ4U (Rietz et al., 2021): GUI design to support non-programmers; tightly integrated with Pepper

Alternatives for WoZ Framework Development

Domain Specialization vs. Generalizability

- Ozlab (Peterson and Wik, 2020): systematic review showing that overspecialization leads to lifespan of 2-3 years

  - Aim for a general-purpose approach from the start

  - Build in a flexible wizard interface to adapt to experimental needs

Alternatives for WoZ Framework Development
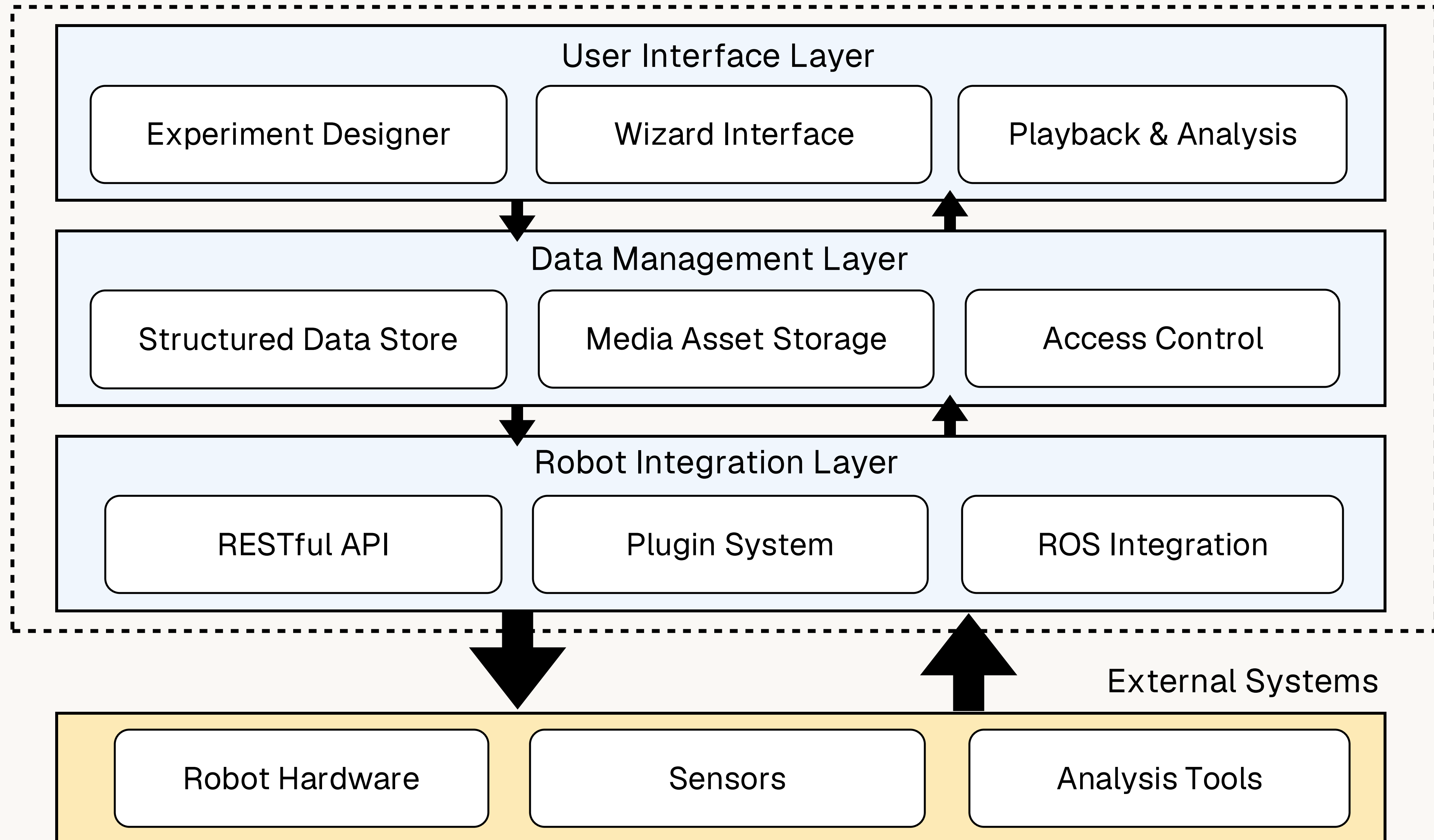
Standardization Efforts and Methodological Approaches

- Porfirio et al., 2023: follow an interaction specification language to define and communicate robot behaviors across different platforms; aim for modularity

- Riek, 2012: aim for methodological transparency to enable reproducibility

Design Goals

The most desirable WoZ support frameworks should:

- Remain usable over non-trivial periods of time

- Require minimal to no programming expertise so that they are usable by interdisciplinary teams in collaborative work

- Embody methodological standardization of experimental protocols

- Handle comprehensive data collection and organization

- Support the complete lifecycle of experiments from design, to execution, to asset management and documentation, and to data analysis to support reproduction by third parties

Collaborative and Reproducible HRI Research Through a Web-Based Wizard-of-Oz Platform

HRIStudio

User Interface Layer

| Experiment Designer | Wizard Interface | Playback & Analysis |

Data Management Layer

| Structured Data Store | Media Asset Storage | Access Control |

Robot Integration Layer

| RESTful API | Plugin System | ROS Integration |

External Systems

| Robot Hardware | Sensors | Analysis Tools |

Experiment Design Formalism

Study

A study is the highest level container in a hierarchical description. It contains one or more experiments.

Experiment Design Formalism

Study

Example: *investigate the most adequate morphology of a robot to act as server in an automated coffee shop.*

Experiment Design Formalism

Study

Experiment i

An experiment embodies one of the goals of the larger study (think of it as 'what answers a research question'). It contains various trials.

Experiment Design Formalism

Study

Experiment i

Example: investigate customer trust in the service provided by a non-humanoid robot.

Experiment j

Example: investigate customer trust in the service provided by a humanoid robot without legs (like Pepper).

Experiment k

Example: investigate customer trust in the service provided by a humanoid robot with legs (like NAO).

Experiment Design Formalism

Study

Experiment i

Trial x

A trial consists of one replication of the experimental script.
It contains one or more steps. All trials follow the same script.

⋮

Experiment Design Formalism

Study

Experiment i

Trial subject x

Example: take order from subject, relay to barista, an bring order to subject.

Trial subject y

Example: take order from subject, relay to barista, an bring order to subject.

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Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

A step is a behavior for either the robot or wizard to perform comprising one or more actions.

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

A step is a behavior for either the robot or wizard to perform comprising one or more actions.

Example: the robot greets a newly arrived customer.

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

Action ⊠

An action is a specific, atomic task for either the wizard or the robot to perform.

Experiment Design Formalism

Study

Experiment i

Trial subject x

Step a

Action ⬚

Example: robot moves up to customer

Action ⬚

Example: robot greets customer with "hello there"

Action ⬚

Example: wizard waits for customer response

Action ⬚

Example: wizard selects new robot utterance

Using the Platform
Running a Sample Experiment

A Sample Experiment
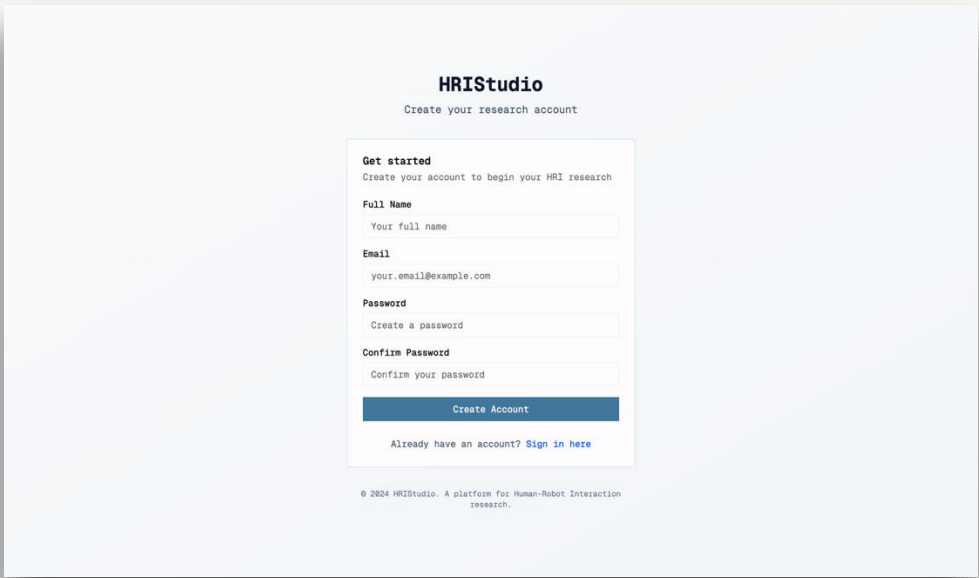
Create Account
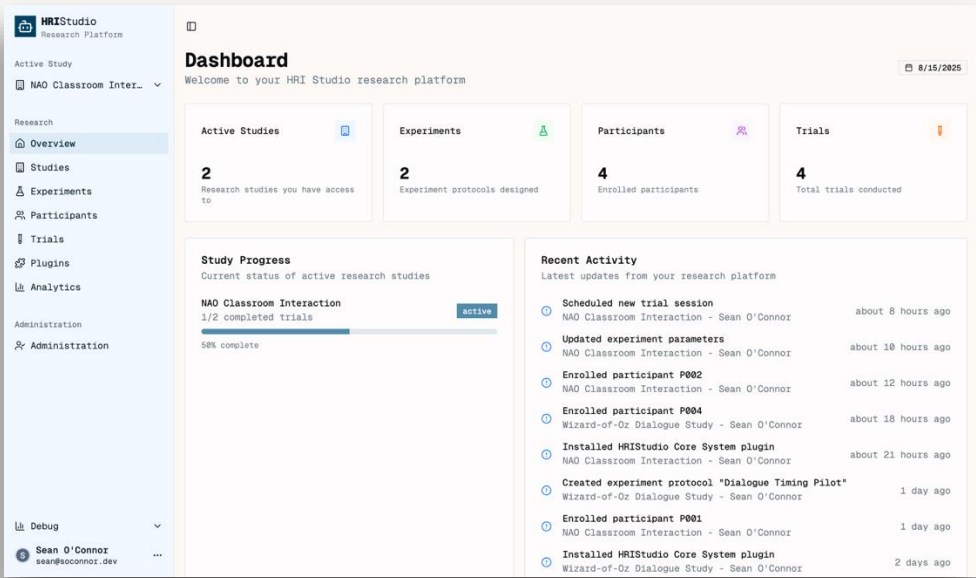
Dashboard
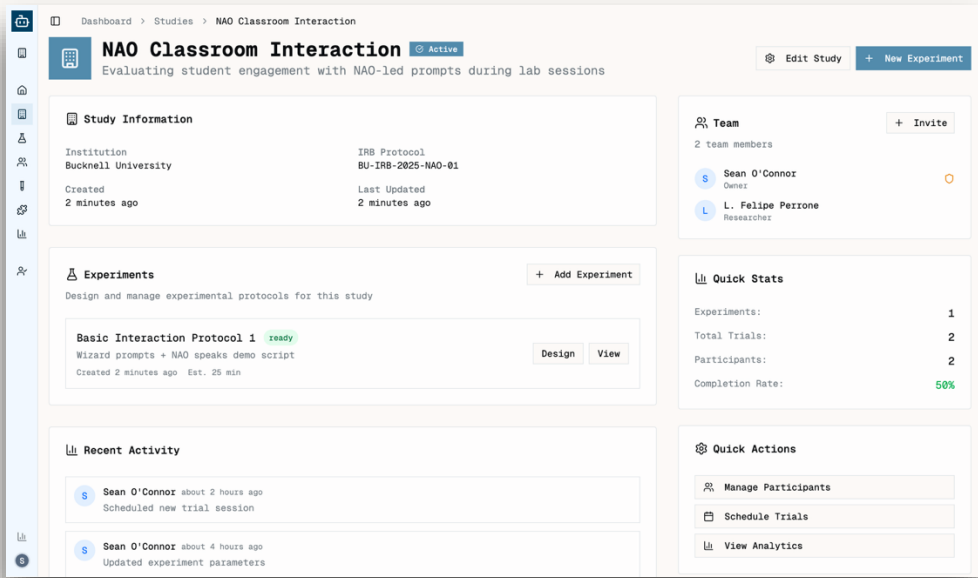
Create Study
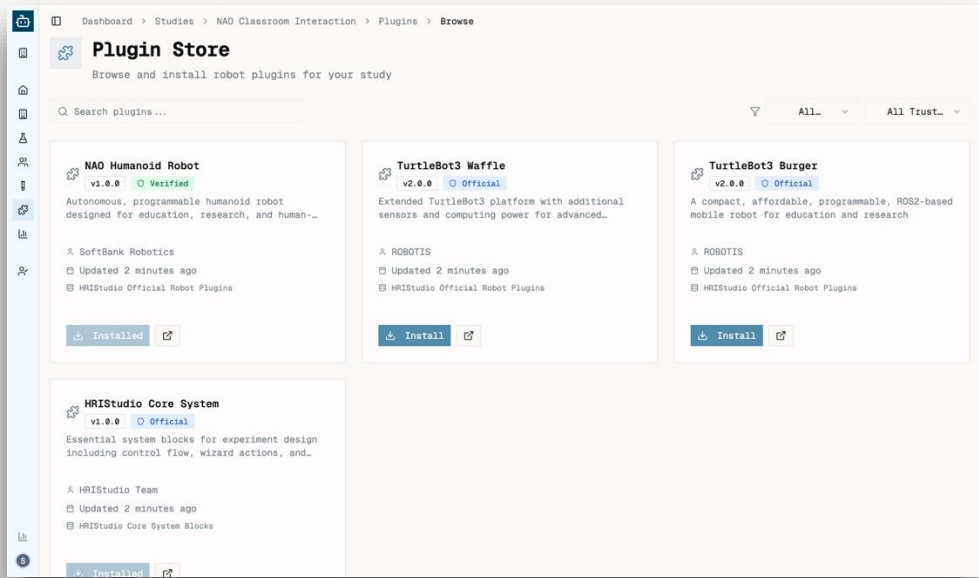
Add Plugins
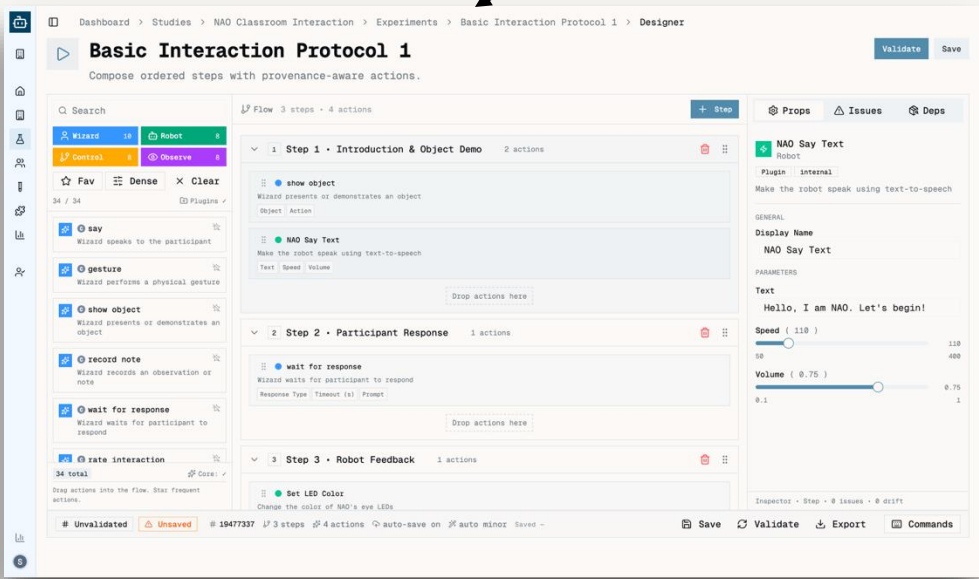
Create Experiment
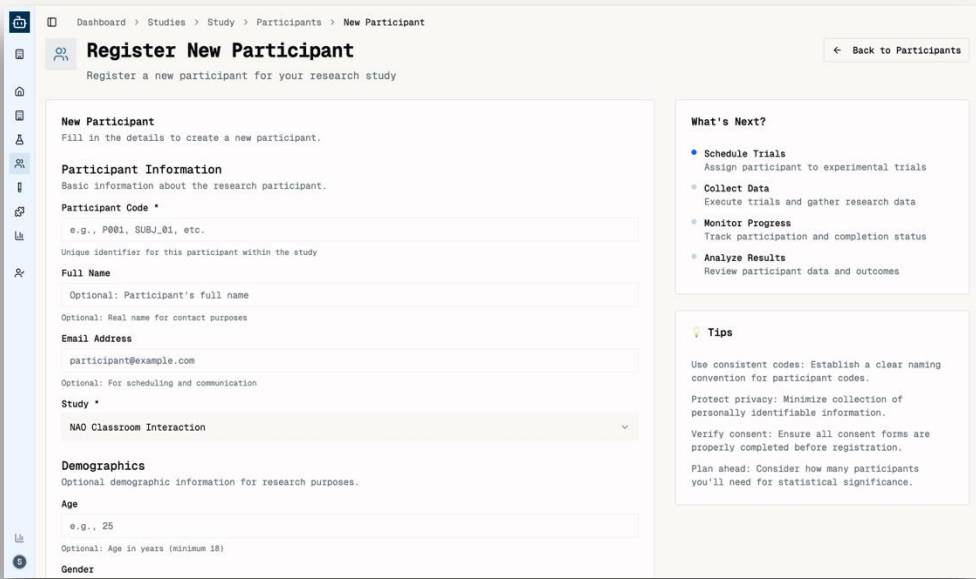
Add Participants
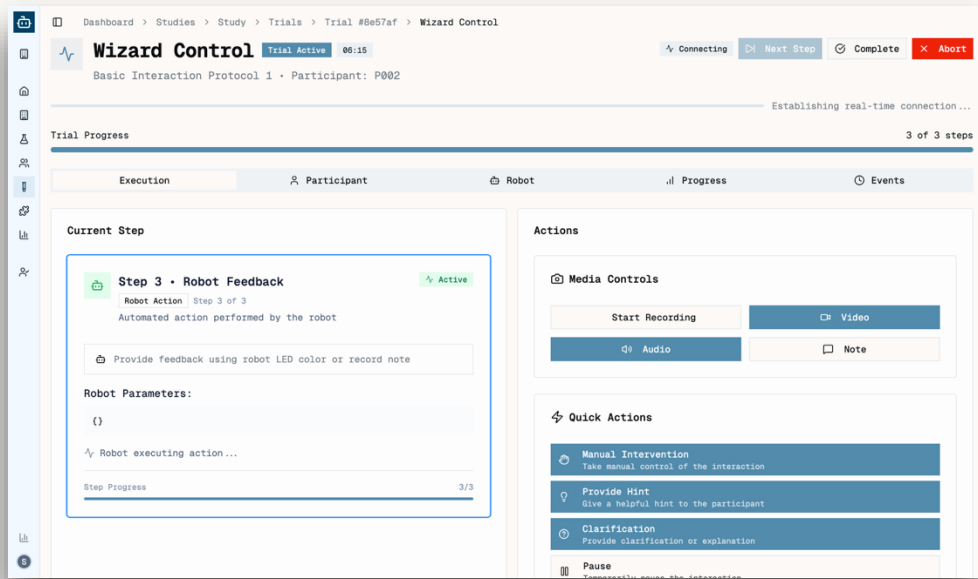
Run Trial
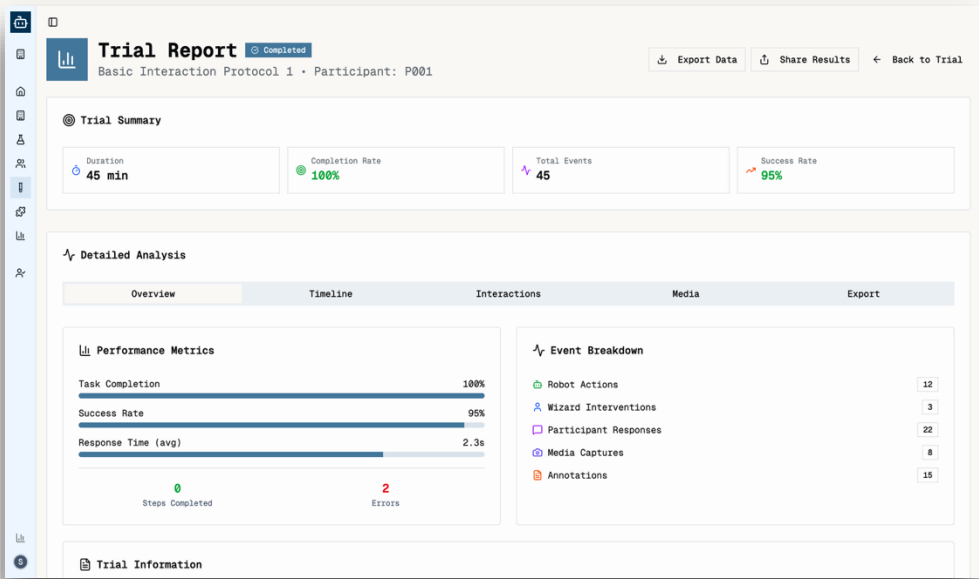
View Report

Create an Account

HRIStudio

Create your research account

Get started

Create your account to begin your HRI research

Full Name

Your full name

Email

your.email@example.com

Password

Create a password

Confirm Password

Confirm your password

Create Account

Already have an account? Sign in here

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Account info:
- Name
- Email
- Password

Accounts are needed to assign roles to users; PI, wizard, observer, designer, etc.

View the Dashboard
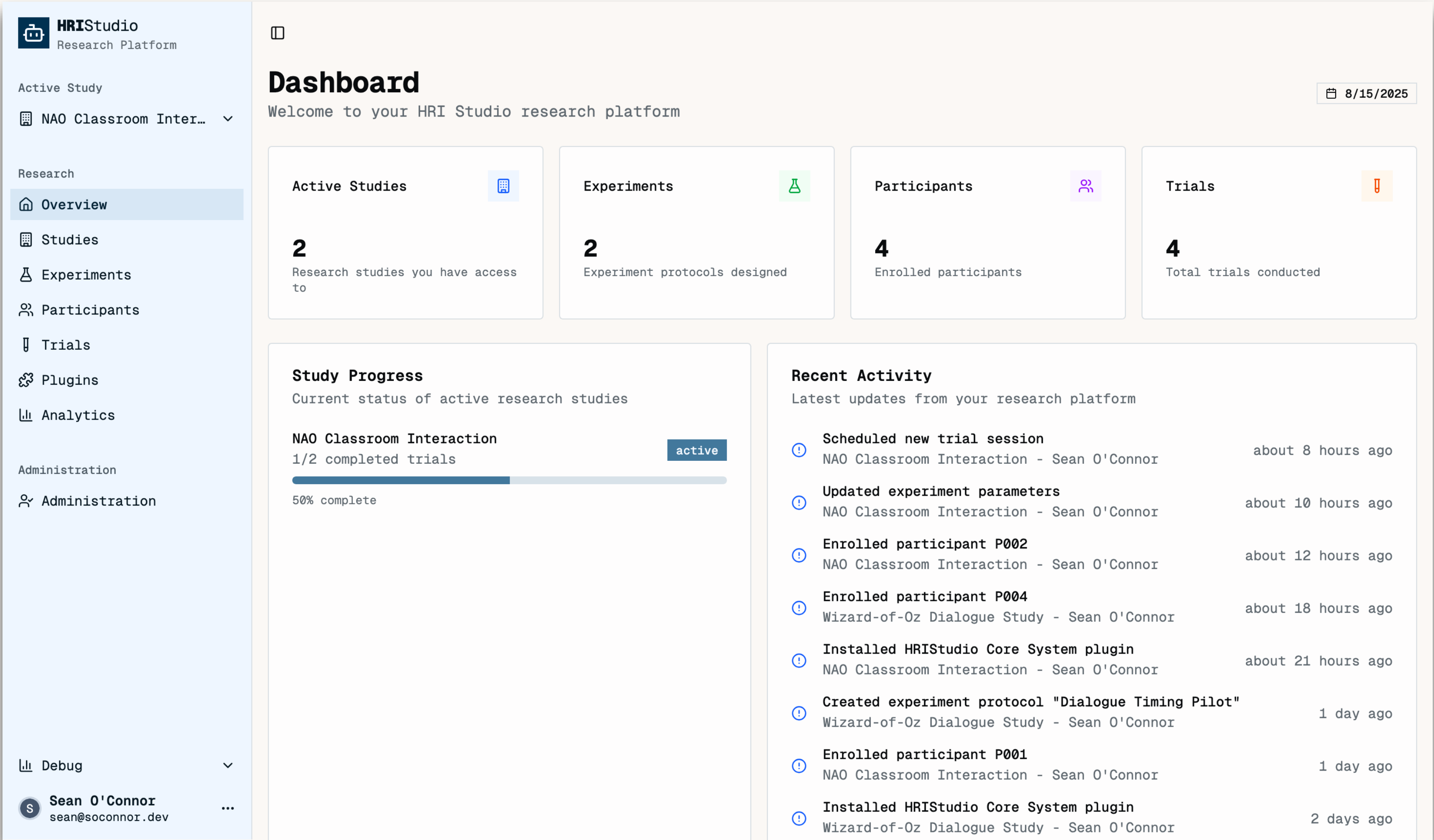
Dashboard aggregates data about all studies. "Up Next view"

- Active studies
- Progression metrics
- Notifications

Create a new Study

The Study details page allows for basic study data to be viewed and modified.

- Metadata
- Experiments
- Team members
- Activity

Install Plugins
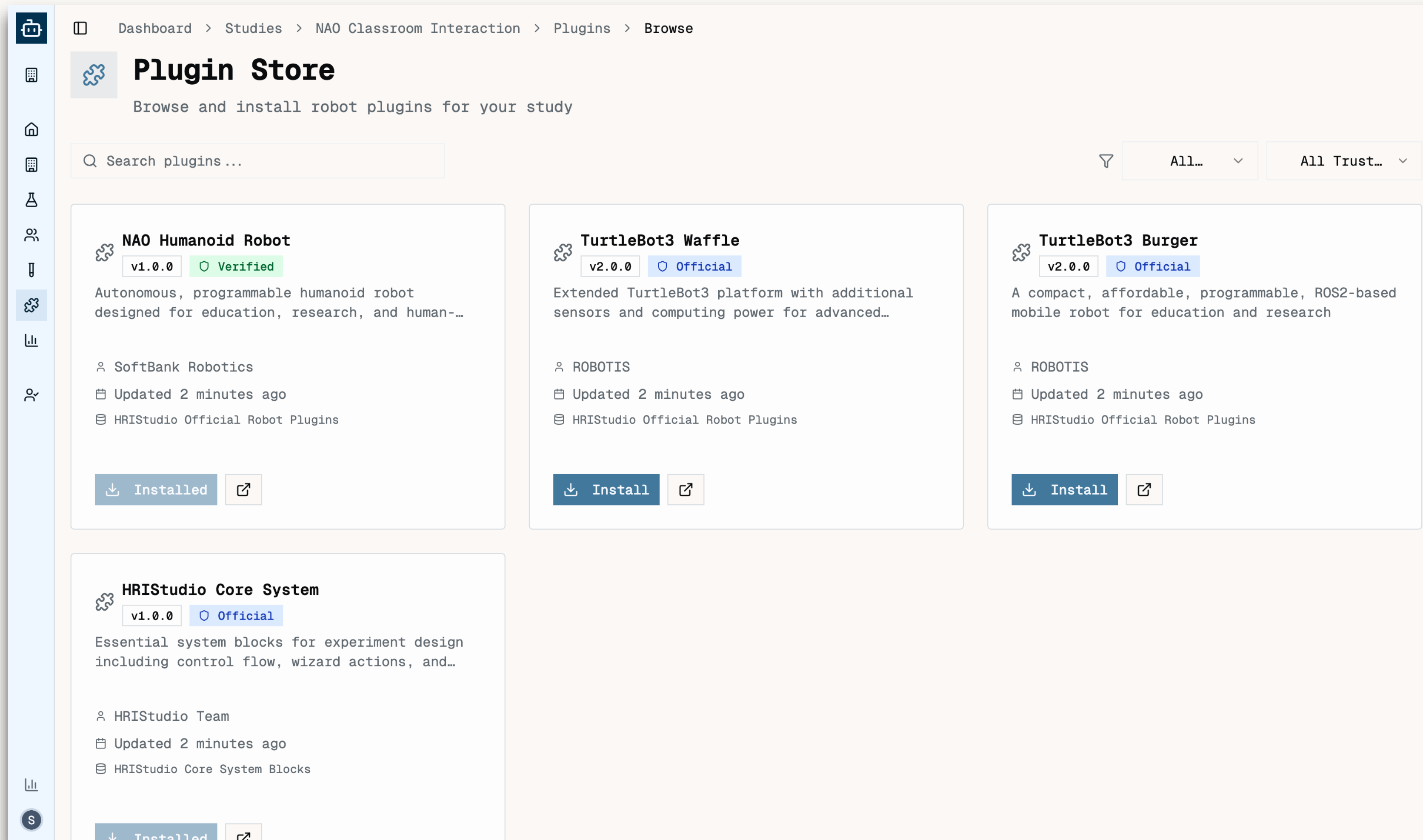
The plugin store allows for plugins to be installed.

- Plugins contain robot-specific actions
- Allows for selection of platform(s)
- Community contributions encouraged!

Design a new Experiment
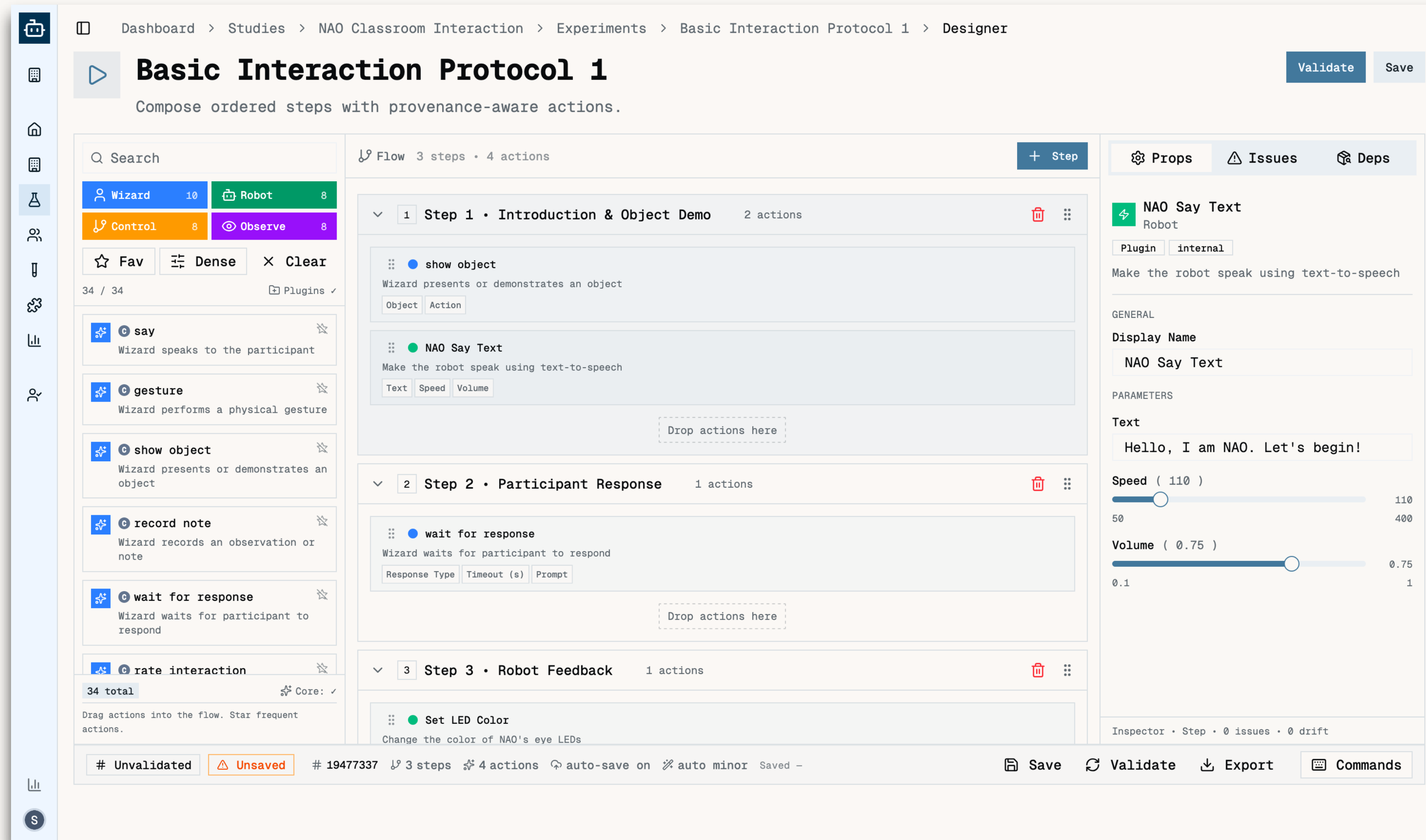
The Experiment designer is split up into three panes:

- Action pane
- Flow pane
- Properties pane

Validation ensures experiments are runnable before save.

Register a new Participant

Participant registration:

- Internal reference code (anonymization)
- Name
- Contact
- Optional additional study-specific fields

Run the Trial
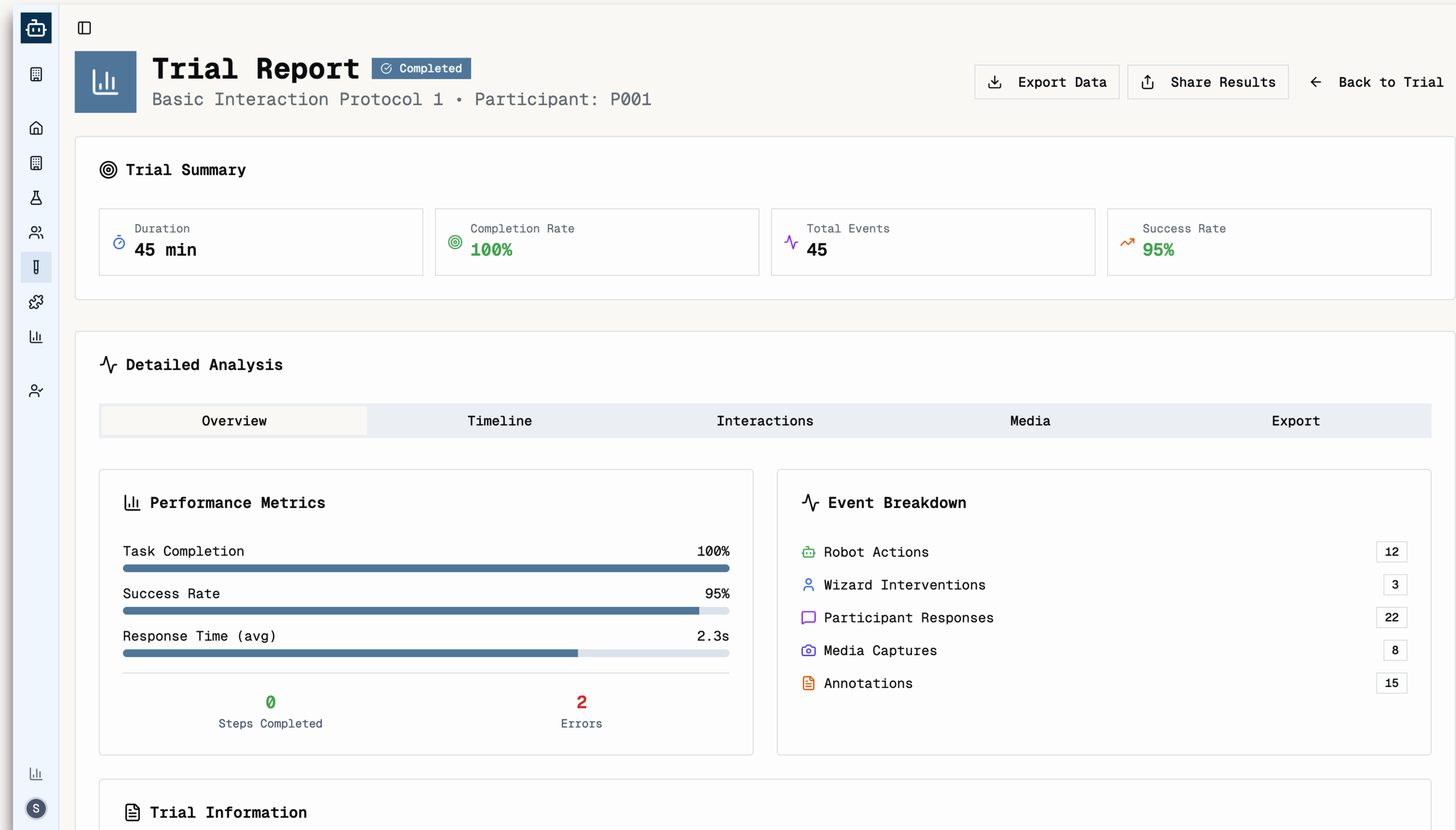

Wizard Control:

- Progresses through experiments step-by-step
- Allows for manual intervention, records script deviations
- All events are logged for future analysis

View the Trial Report

Trial Report:

- View trial events over a timeline
- Basic performance metrics calculated from wizard input
- See any manual interventions and problems that occurred
- Allows for further analysis

Contribution

- Our approach was integrative (based on prior work in the literature) and our aim is to take a further step toward a system that guides non-experts to perform collaborative HRI research

- Our contribution: in the near term it is a software tool that consolidates design objectives into a proof of concept platform; in the long term, we left the community with the lessons we learned

Future Work

- Complete implementation: We will finalize remaining platform features and conduct incremental testing throughout development

- Internal validation: We will conduct controlled case studies to evaluate platform effectiveness across diverse HRI research scenarios

- Open beta program: We will launch community testing and recruit HRI researchers to gather real-world feedback and refine the platform before general release

Thank you!
Any questions?

Link to paper:

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