A TOOLKIT FOR DATA VISUALIZATION EXPERIMENTS

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AGENDA

30 Minute reVISit Overview

15 Minute Discussion

Then: Hands-On Tutorial (2h)

Goal: get revisit working for you

- Build a simple study
- Components and the reVISit Spec
- Data Analysis in reVISit
- Creating a React Component
- Provenance Tracking
- Randomization Strategies in reVISit
- Deployment
- reVISit-py –Python Bindings
- Recruiting participants
- Data Storage (Firebase)

PERILS OF ONLINE VISUALIZATION EXPERIMENTS

There is no **end-to-end platform** for building **interactive experiments**

The support for **types of stimuli** in survey tools are limited

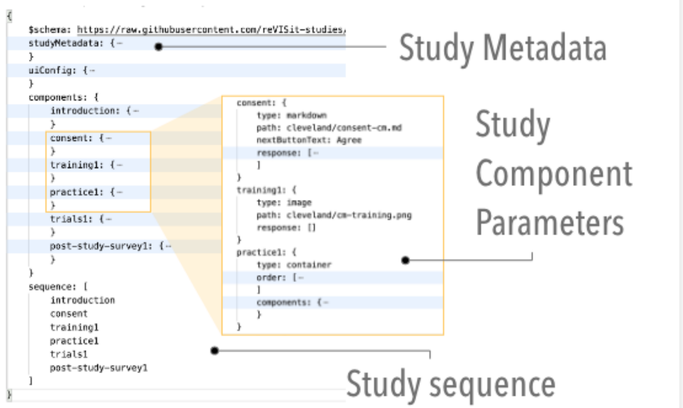
Lack of experiment **debugging** features

No built-in **data collection** and **provenance tracking** functions

The Scope of reVISit

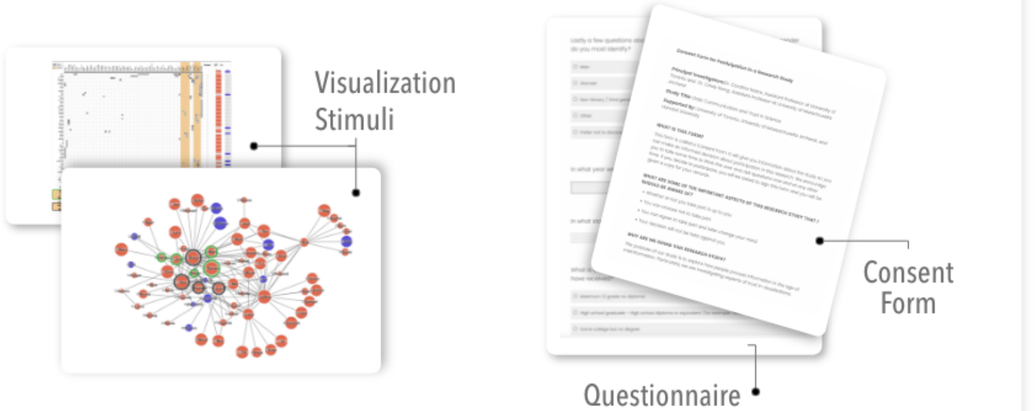
reVISit DSL - study specification

1



Study Stimuli & Components

2



Compile & Deploy

Interactive Study Web App

3

Task Instructions | Study Stimulus | Admin Panel

Data Management

4

Data Storage (Firebase)

Data Download (tidy text/csv, JSON)

Data Analysis

5

Study Analytics Interface

[reVISit CHI'21] & Future Work

External Data Analysis

R SPSS

WHAT IS REVISIT: INFRASTRUCTURE FOR VIS STUDIES

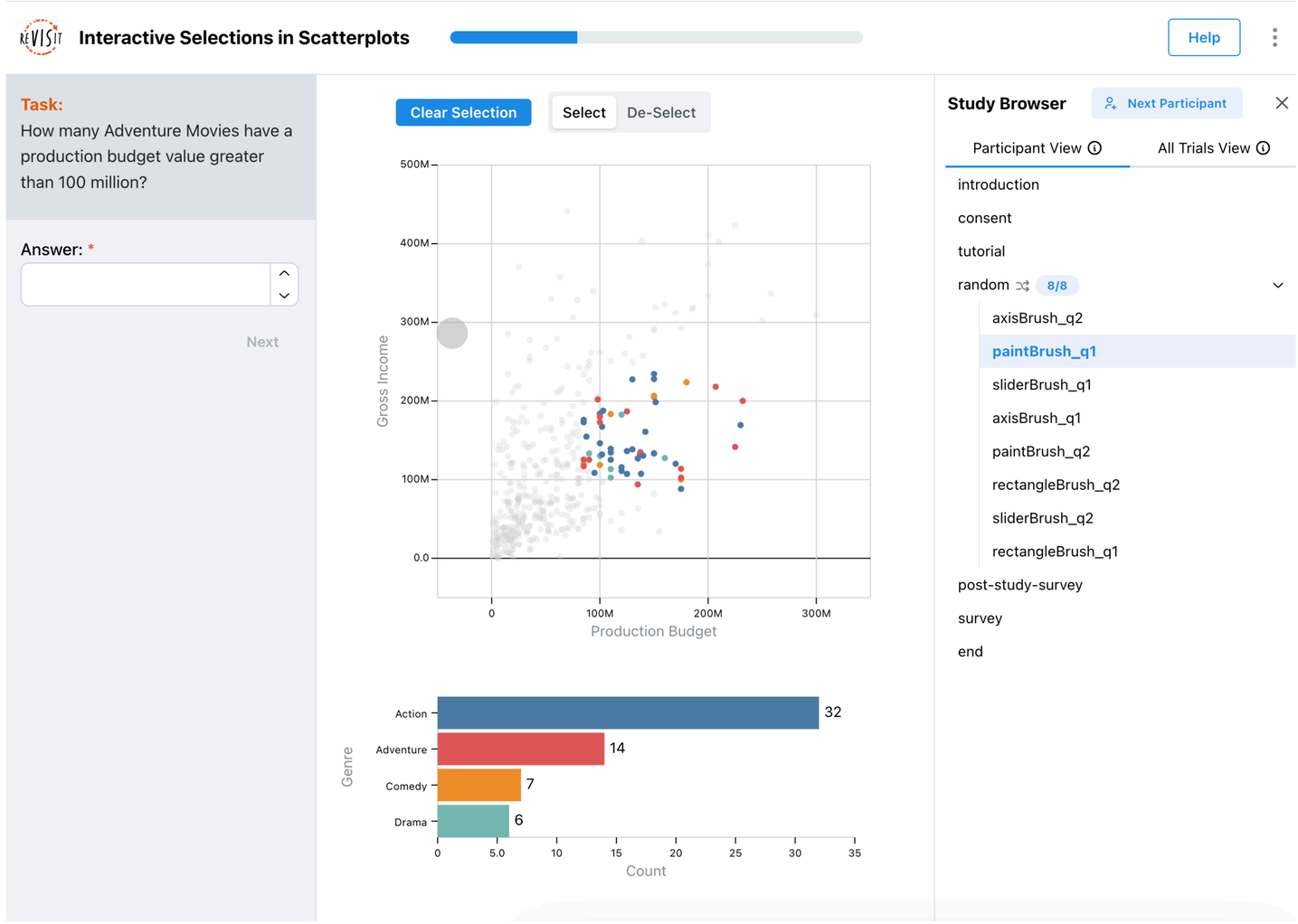
Set up studies with all **components** (consent, training, trials, tasks, surveys, etc.) including sophisticated **study designs** (randomization)

Simple **data tracking and data export**

Simple to **deploy and run** studies

Fully **reproducible and open**. You can share your whole study setup for anyone to re-run, without having to have a license for software (qualtrics).

DEMO



https://revisit.dev/study/example-brush-interactions/

WHY REVISIT?

Designed for **sophisticated studies**

randomization, complex stimuli, complex data tracking

Reproducible and Open Studies!

Non-commercial license lets you **share your study!**

Extensible – add on features you need

Code not GUI! (though there might be a GUI option in the future)

Support from us!

THE REVISIT SPEC

Define the details of your experiment as a JSON file.

Study Metadata — name of the study, authors, contact e-mails

UI Config — parameterizing the appearance of reVISit

Components and **BaseComponents** — setting up the content of the study

Sequence — choosing the order and the selection of tasks participants see.

REVISIT SPEC

Outline

```
{
    "$schema":  "https://raw.githubusercontent.com/reVISit-studies/study/main/src/parser/
StudyConfigSchema.json",
    "studyMetadata": {
        "title": "Basic Questionnaire Study",
…
    },
    "uiConfig": {
        "contactEmail": "contact@revisit.dev",
…
    },
    "components": {
        "introduction": {
            "type": "markdown",
            "path": "basic-questionnaire-study/assets/introduction.md",
            "response": []
        },
        "first-question-set": {
            "type": "questionnaire",
            "response": [
                {
                    "id": "q1-name",
                    "prompt": "What is your first name?",
                    "type": "longText",
                    "placeholder": "Please enter your first name"
                },
    "sequence": {
        "order": "fixed",
        "components": [
            "introduction",
            "first-question-set"]
    }
```

REVISIT COMPONENTS – WHERE YOUR "STUDY CONTENT" GOES

Markdown Files – introductions, consent forms, help pages, etc.

Images – static (vis) stimuli

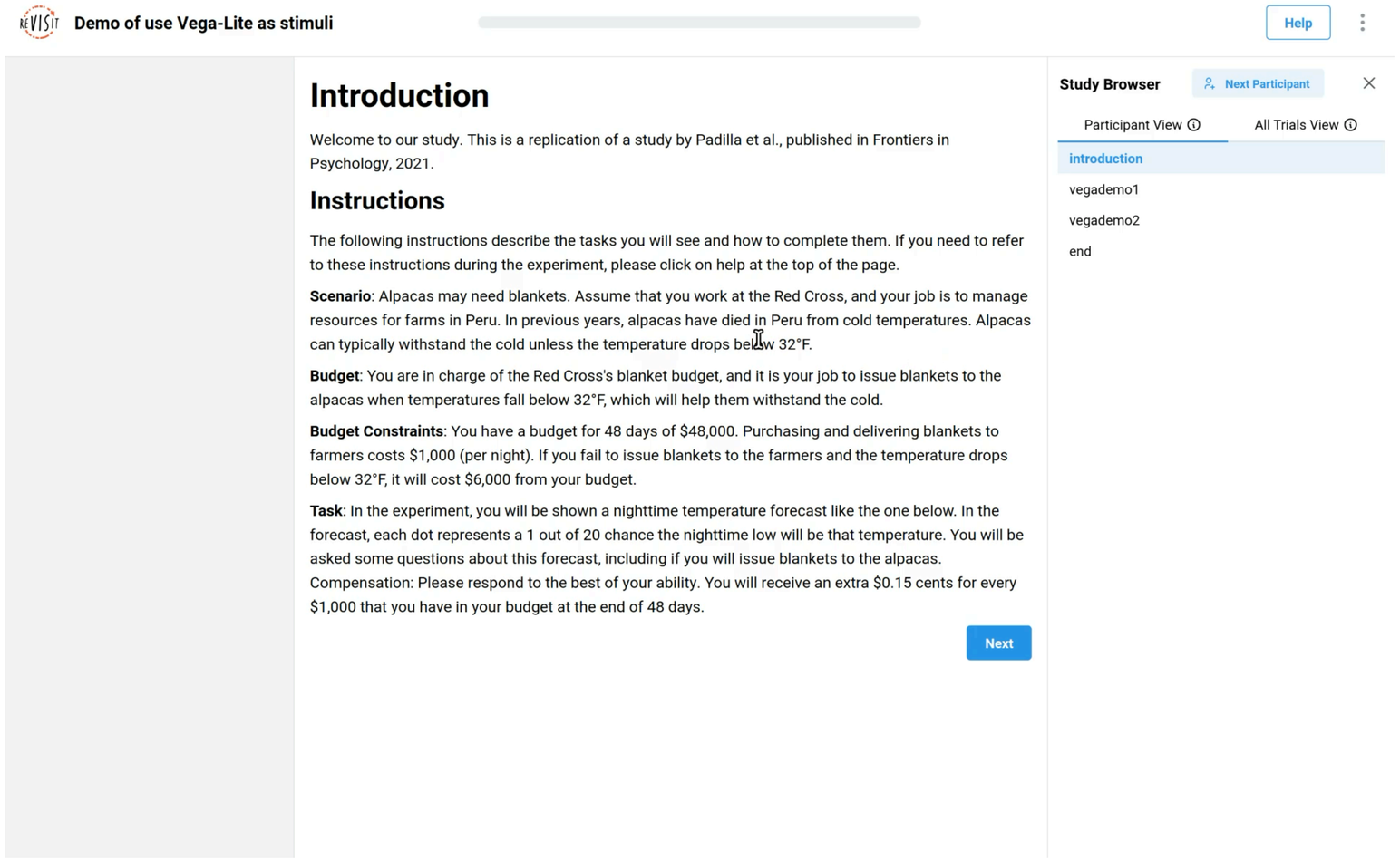
Web Pages – custom stimuli, made interactive with JavaScript

React Components – sophisticated interactive stimuli. Simplify the communication between reVISit and the stimulus

Survey Questions – structured responses

Vega Visualizations – directly put in interactive visualizations as stimulus

VEGA DEMO



Also auto-captures interaction!

REVISIT SPEC

Components & Inheritance

```
    "baseComponents": {
        "bar-chart": {
            "type": "website",
            "response": [
                {
                    "id": "barChart",
                    "prompt": "Your selected answer:",
                    "required": true,
                    "location": "belowStimulus",
                    "type": "iframe"
                }
            ],
            "path": "basic-questionnaire-study/assets/bar-chart.html",
            "instructionLocation": "aboveStimulus"

        }
    }

"bar-chart-1":{
    "baseComponent": "bar-chart",
    "description": "A trial for the user to click the largest bar",
    "instruction": "Click on the largest bar",
    "parameters": {
        "barData": [0.32, 0.01, 1.2, 1.3, 0.82, 0.4, 0.3]
    }
},
"bar-chart-2":{
    "baseComponent": "bar-chart",
    "description": "A trial for the user to click the smallest bar",
    "instruction": "Click on the smallest bar",
    "parameters": {
        "barData": [1.2, 1.2, 1.2, 1.3, 0.82, 0.4, 0.3]
    }
}
```

COMPONENTS AND RESPONSES

Responses are a **primary data type - each component can have a response**

Form elements are “responses only”

Component

Response

```
"first-question-set": {
                "type": "questionnaire",
                "response": [
                    {
                        "id": "q1-name",
                        "prompt": "What is your first name?",
                        "required": true,
                        "location": "aboveStimulus",
                        "type": "longText",
                        "placeholder": "Please enter your first name"
                    },
```

SEQUENCE

In what order do the components appear for which participant

- Can be made up of **nested blocks**
- **Fixed**
- **Random**
- **Latin Square**
- **Subsets** (show 2 out of 5)
- **Skips** (if wrong, go to next task)
- **Interrupts** (breaks, attention checks)

REVISIT SPEC

Sequence

```
"sequence": {
        "order": "fixed",
        "components": [
            "introduction",
            "consent",
            "tutorial",
            {
                "order": "random",
                "components": [
                    "paintBrush_q1",
                    "rectangleBrush_q1",
                    "axisBrush_q1",
                    "sliderBrush_q1"
                ]
            },
            "post-study-survey",
            "survey"
        ]
    }
```

REVISIT-PY

Python Bindings for reVISit

Some things are annoying to do in JSON

Eg: generating 50 stimuli with slightly different data

reVISit-PY Python bindings allow you to “program” a spec

REVISIT-PY EXAMPLE

```
import revisit as rvt
import data.scatterjnd.metadata as metadata

study_metadata = rvt.studyMetadata(
    **metadata.study_metadata
)

newResponse = rvt.response(
    id='hello',
    type='matrix-radio',
    required=False,
    prompt='Test Prompt',
    test='hello',
    answerOptions='satisfaction5',
    questionOptions=['Test1', 'Test2']
)

base_comp = rvt.component(
    type='questionnaire',
    response=[],
    component_name__='Base_Test'
)

comp_one = rvt.component(
    base__=base_comp,
    component_name__='Test',
).responses([
    newResponse
])
```

requirements.txt | widget.tsx | test.ipynb U | bar-chart.html U | revisit-widget_all.json | widget.py | .gitignore

+ Code | + Markdown | Run All | Restart | Clear All Outputs | Variables | Outline | ... | .venv (Python 3.12.8)

```
import src.revisit as rvt

study_metadata = rvt.studyMetadata(
    **{
        "title": "HTML as a Stimulus",
        "version": "pilot",
        "authors": [
            "The reVISit Team"
        ],
        "date": "2023-04-14",
        "description": "A simple demo of using stimuli in an HTML file that renders a D3 visualization. Data is collected via a numeric response field.",
        "organizations": [
            "University of Utah",
            "WPI",
            "University of Toronto"
        ]
    }
)

ui_config = rvt.uiConfig(
    **{
        "contactEmail": "contact@revisit.dev",
        "helpTextPath": "./assets/help.md",
        "logoPath": "./assets/revisitLogoSquare.svg",
        "withProgressBar": True,
        "autoDownloadStudy": False,
        "sidebar": True,
        "windowEventDebounceTime": 200
    }
)

introduction = rvt.component(
    component_name__='introduction',
    type='markdown',
    path='./assets/introduction.md',
    response=[]
)

barChart = rvt.component(
    component_name__='barChart',
```

[ ]

main* | 0 0 | 0 | Ln 1, Col 2 | Spaces: 4 | Spaces: 4 | LF | Cell 2 of 4

DATA COLLECTION

Responses – Participant responses to specified questions

Logs – a variety of things about participants and sessions

- **time** information about responses
- **“Clean” time** - minus “browsed away” time
- **Participant Metadata**: Browser information, etc

Provenance Data – data you track in your stimulus via our provenance tracking library

Audio Data – you can run think aloud studies (more later)

PROVENANCE DATA

Instrument your interactive stimulus with provenance tracking!

E.g., using our **trrack library**

Works out **of the box for Vega!**

https://apps.vdl.sci.utah.edu/trrack

Provenance **data is stored as JSON** with the rest of your data

PROVENANCE DATA

New analysis possibilities!

- Analyze **logs**
- Analyze **interaction strategies**

Review individual user actions

- **Debug** your study setup
- See where things go **wrong**

Review Demo

DATA STORAGE: LOCAL OR FIREBASE

Local

- Works out of the box
- Download from local storage of your browser
- Doesn’t work for online studies

Firebase

- A bit of a pain to set up (but better than running your own server)
- Reliable cloud storage option
- Available with servers in many countries

STUDY MODES — EXPERIMENT LIFECYCLE

Study Design & Debugging

Jump around a study, see all data, see run-throughs of pilots

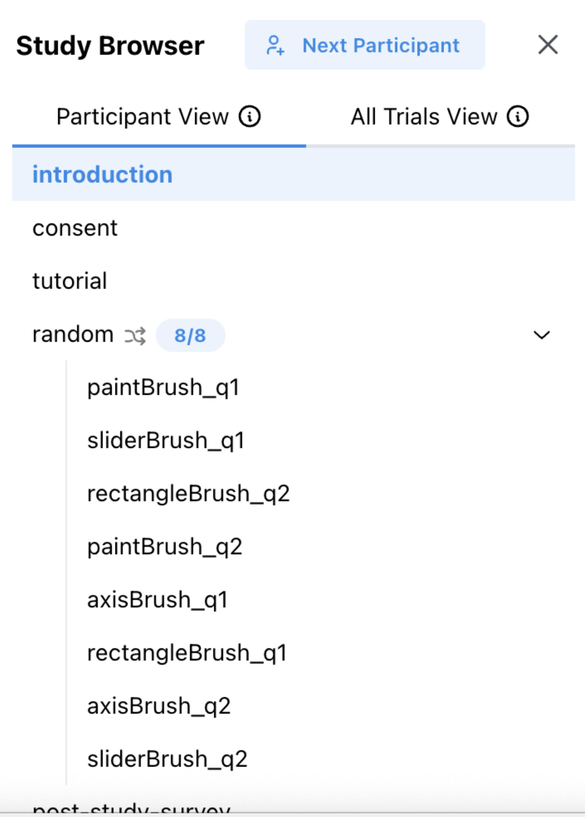
Collecting Participant Data

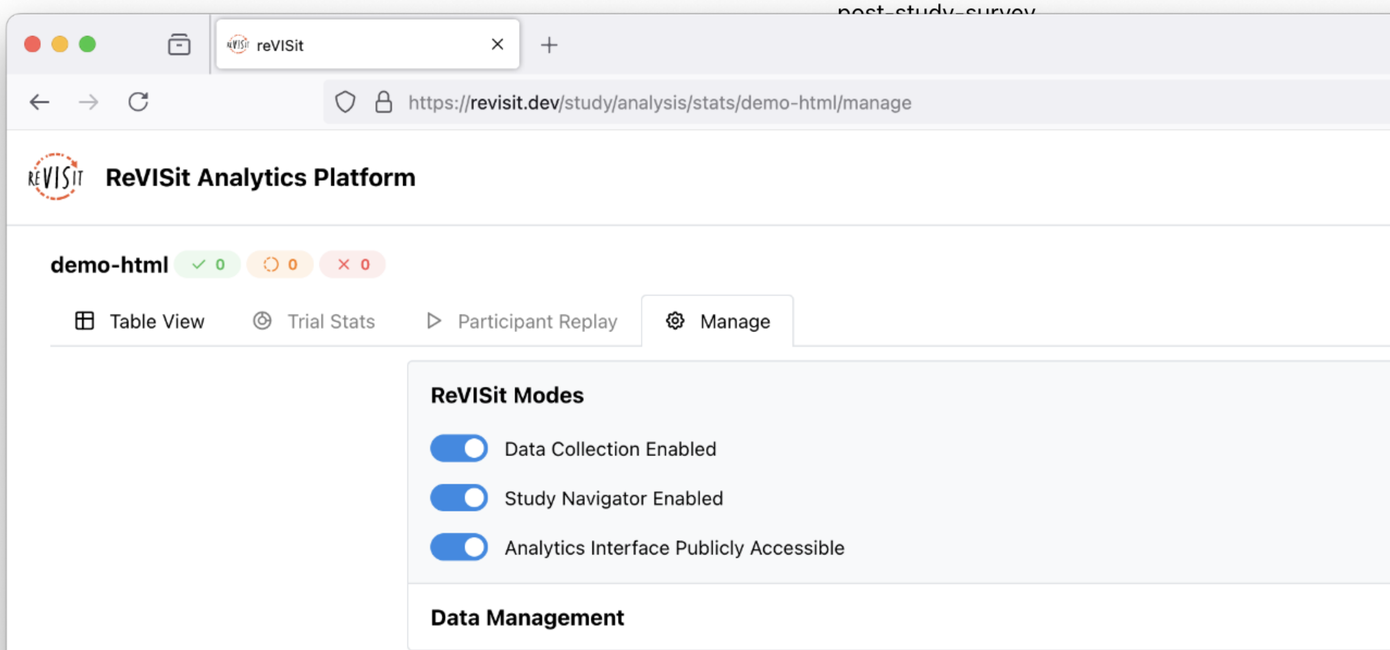
Hide all debug features

Study & Data Dissemination

Share study w. navigation

Share data

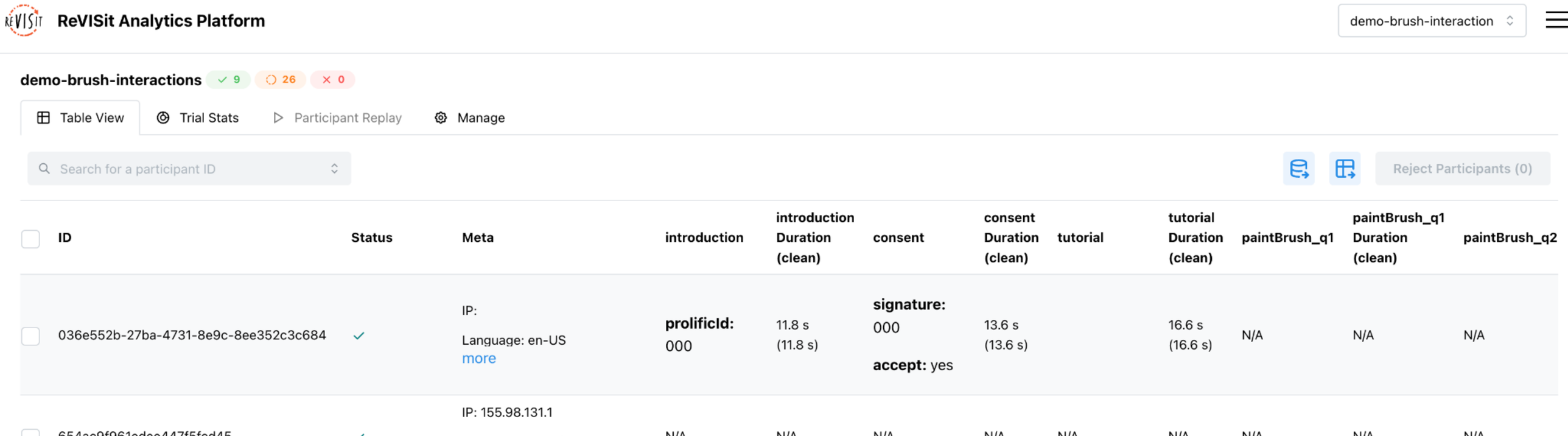




ANALYSIS INTERFACE

Download the data as tidy csv or JSON

Review and reject trials

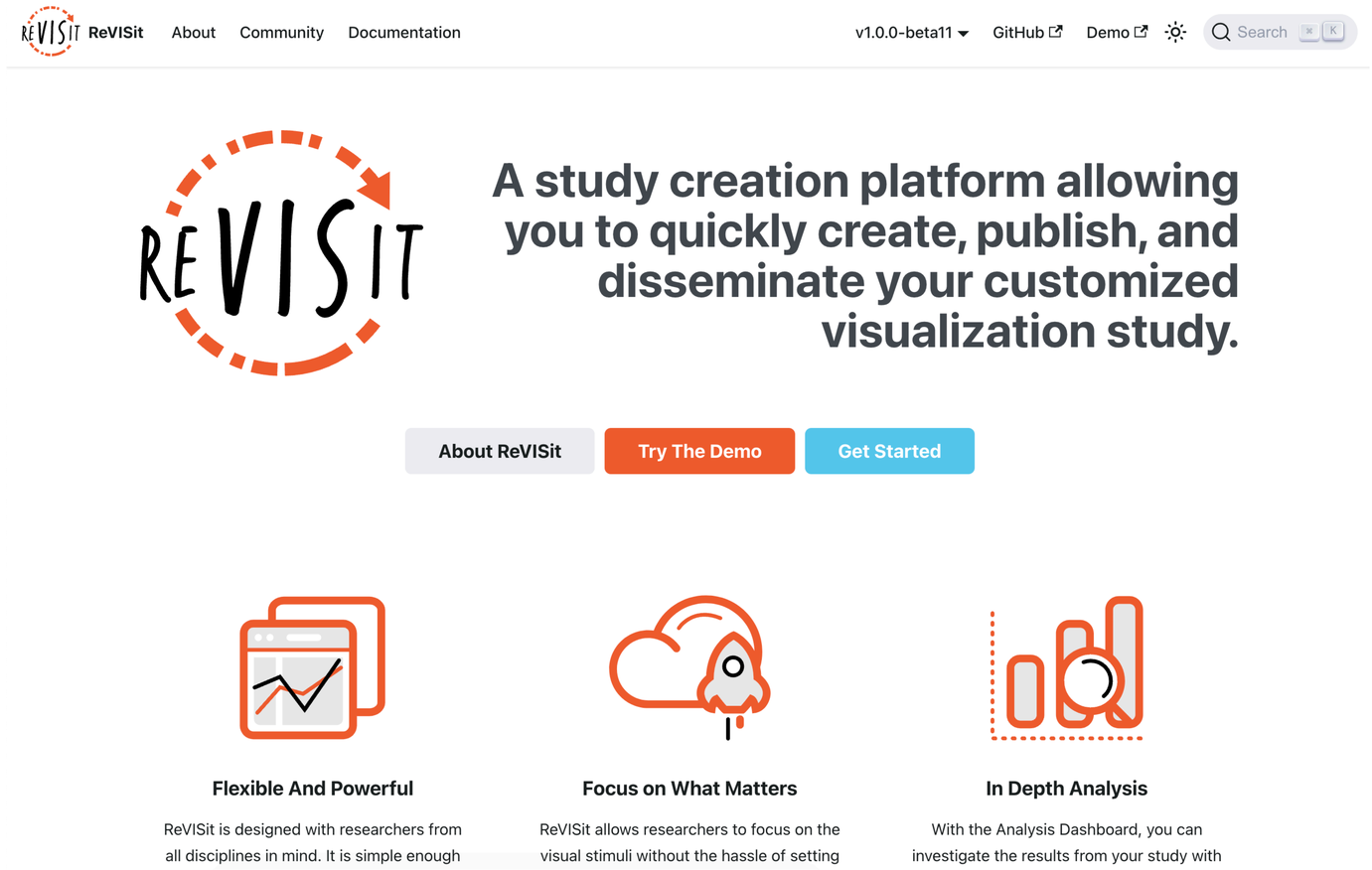


DOCUMENTATION & COMMUNITY

Documentation & Tutorials on Website

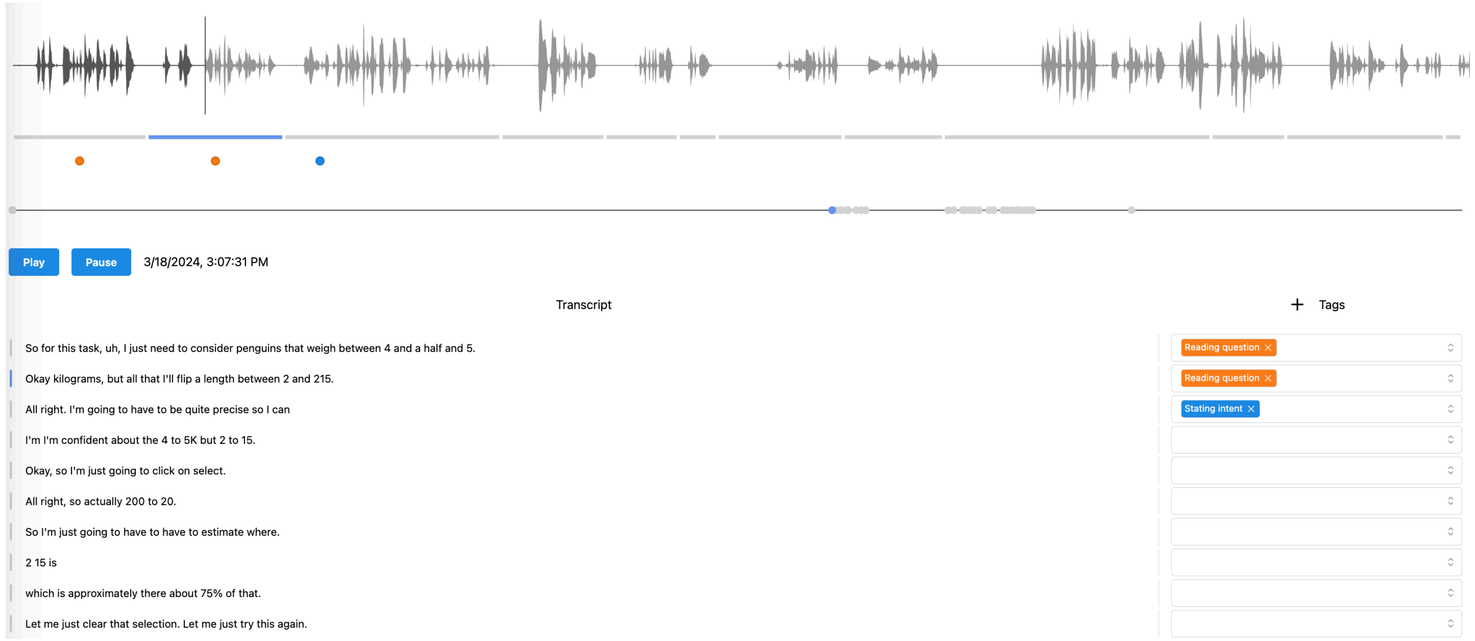
Community participation via slack etc.

https://revisit.dev



CAN WE DO QUALITATIVE EVALUATION ONLINE?

Yes! Think Aloud & Provenance



Pushing the boundary of what can be evaluated using crowdsourcing

THINK ALOUD PROTOCOL

A UI/UX Method for finding usability issues in software

Participants sit in a **lab**

Instructed to "**speak their thoughts**" as they use an interface

Audio is recorded

Screen is recorded

Logs may be recorded

Experimenter is **present**

PURPOSE

Traditional focus on “**Defects**” and UI Issues

Vis community also uses it to analyze **Insight Formation** with visualizations

REVIEWED 67 TA STUDIES IN VIS

66 were synchronous (lab or zoom)

27 evaluated insights

Participants:

- **experts** – evaluating a domain-specific system (small n)
- **novices & skilled participants** (large n, 20-50)

RESEARCH QUESTIONS

Can we build a **system** that makes **recording and analyzing TA studies** online easy?

Do **crowdsourced TA studies** actually **work**?

WHY?

Logistics are easier

- Crowdsourcing
- Expert-studies at their schedule

Potentially more **diverse participant pools**

Time-saving for experimenter

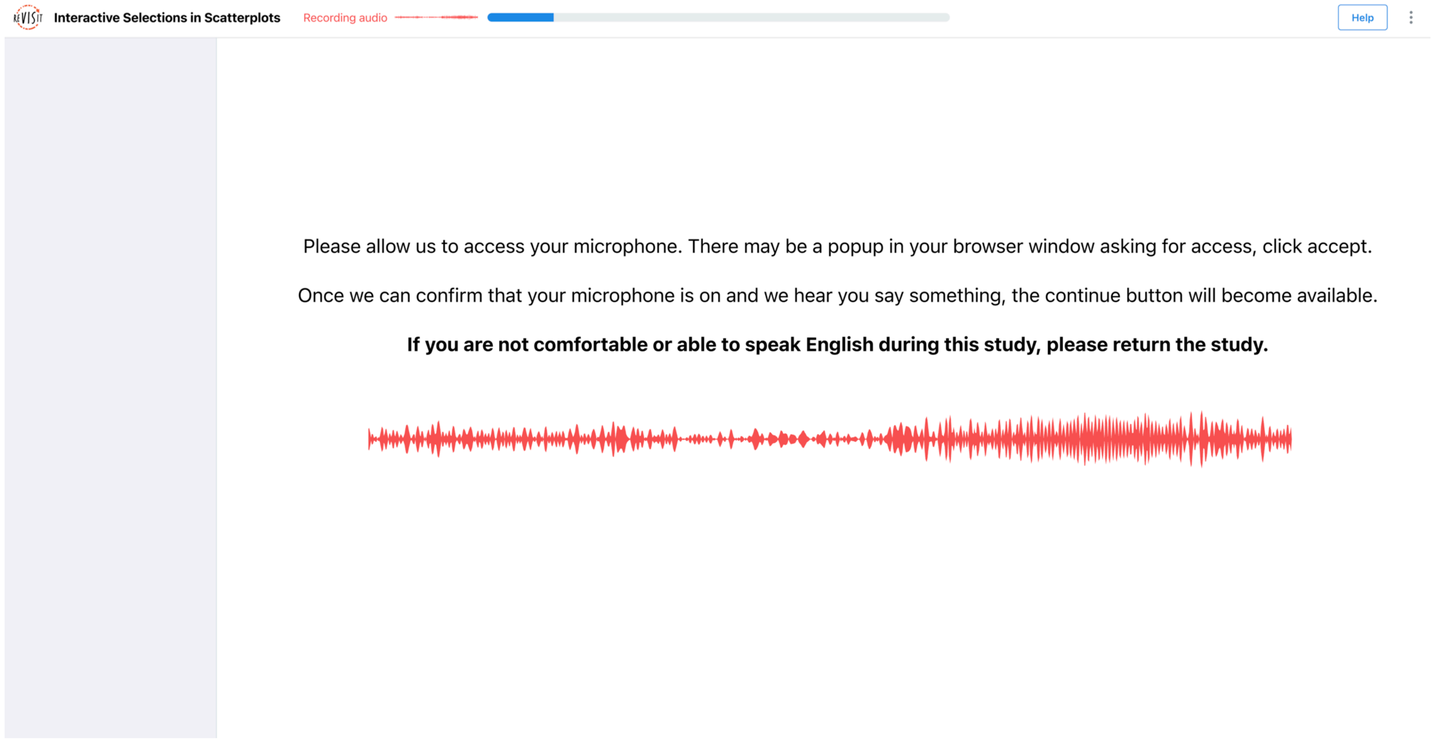
Usual trade-offs of lab vs crowdsourced

RECORDING

Single flag

Waveform vis to show recording is on

Automatic **transcription**



ANALYSIS

Synched with Application State / Events

Easy **editing** of transcripts

Ability to **code** per participant / task / trial

Interactive Selections in Scatterplots

Help

5e5521580ee1b951df544c3c

paintBrush_q4

Play Pause 3/18/2024, 3:08:05 PM

Transcript	Tags
So for this task, uh, I just need to consider penguins that weigh between 4 and a half and 5.	Reading question
Okay kilograms, but all that I'll flip a length between 2 and 215.	Reading question
All right. I'm going to have to be quite precise so I can	
I'm I'm confident about the 4 to 5K but 2 to 15.	
Okay, so I'm just going to click on select.	Stating Intent
All right, so actually 200 to 20.	
So I'm just going to have to have to estimate where.	
2 15 is	
which is approximately there about 75% of that.	
Let me just clear that selection. Let me just try this again.	
Okay. Alright, so that's the 4 to 5K body mass. And then the 2002215.	
So that's giving me those results.	
so the most common penguin There Is the Gen 2	Answering question
and the least common penguin with 5 is the a deli if I've pronounced that correctly.	
Okay clicking.	

Interactive Selections in Scatterplots

Help

Task:

Consider only penguins that weigh between 4k and 5k grams (g) and have flipper lengths between 200 and 215mm. What is the most and least common type of penguin in this subset?

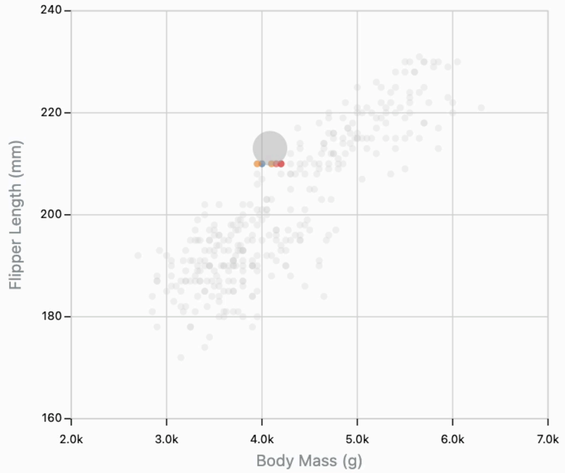
While answering this question, please verbalize your thoughts, especially any insights you have or problems you run into.

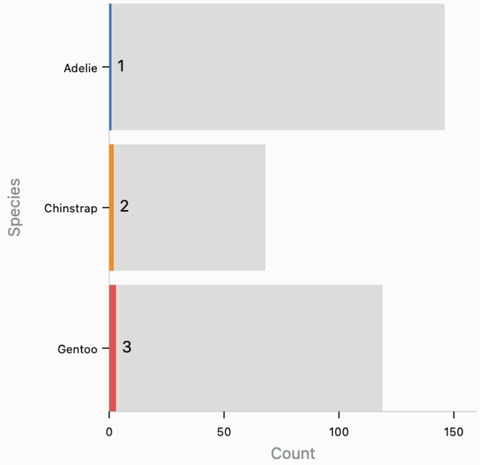
Most common Penguin: *

Least common Penguin: *

Next

Clear Selection Select De-Select





VALIDATION

Do crowdsourced think-aloud studies work?

Study 1: Crowdsourced vs Lab Think-Aloud

Crowdsourced

Lab

Study 2: Online Think-Aloud vs Text Response

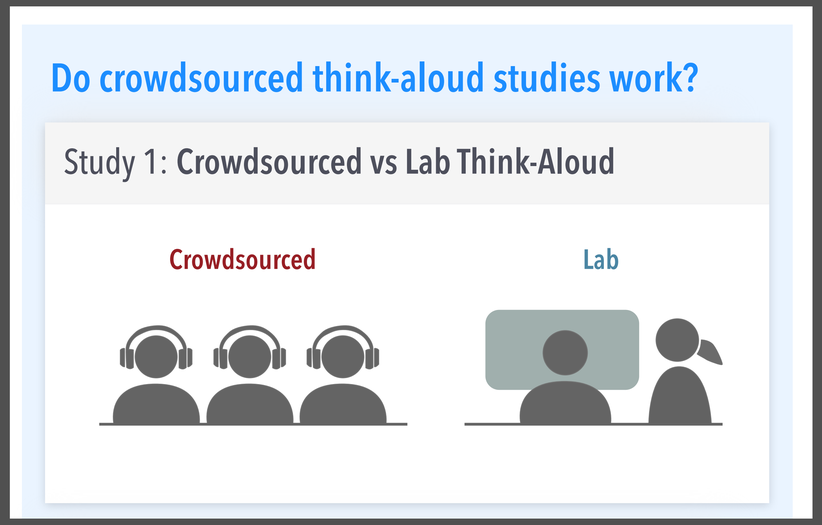
Think-Aloud

RECORD RESPONSE

Text Response

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut ero labore et dolore

SUBMIT RESPONSE



40 online participants

10 lab participants

Stimulus:

interactive vis tool

two views

required interactions to solve tasks

Coding:

Usability

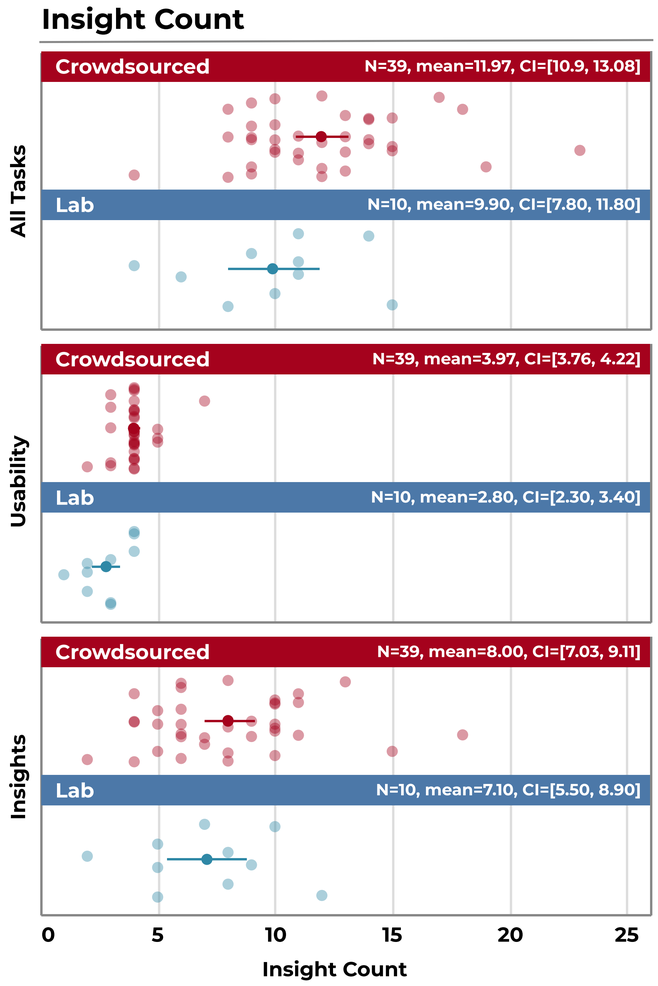
Insights (correct, directed / open, hypothesis, elaborated)…

Do crowdsourced think-aloud studies work?

Study 1: **Crowdsourced vs Lab Think-Aloud**

Crowdsourced

Lab



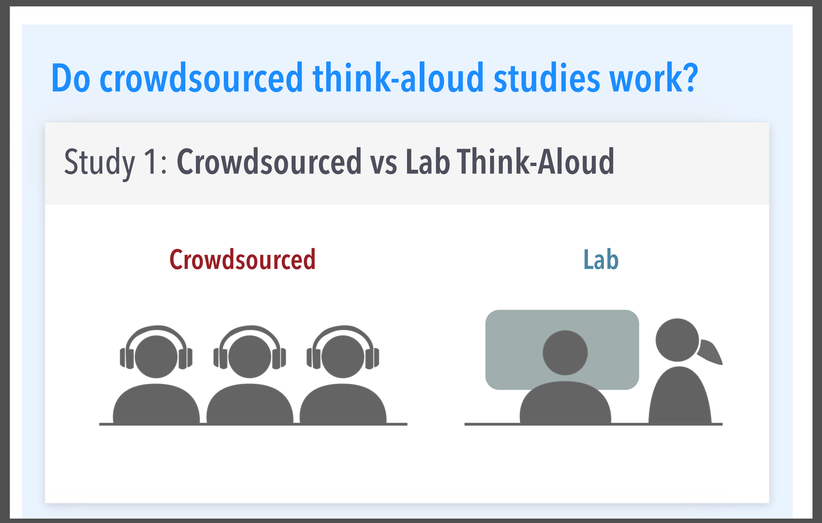
Yes, ppl speak!

1 audio recording unusable

2 required heavy editing

recruiting slightly slower

Nr / quality of insights similar to slightly higher



Crowdsourced comments were more negative

- Bias because of experimenter present in lab setting?

Role of experimenter

- Better introduction
- Clarifying questions

Need to carefully prepare crowdsourced study!

SUMMARY

A TOOLKIT FOR DATA VISUALIZATION EXPERIMENTS

ReVISit takes care of the annoying parts of a study

Gives you the **ability to share your study with** reviewers and community!

Hope you give it a try.

THOUGHTS?