

# Experimental Design: Introduction to PsychoPy

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OTC:



# Link with assessment

Order	Task	%
1	Design, build & explain an experiment	40
2	Write up how to lab instructions include checklist for nibs	10
3	Write up how to lab instructions include checklist for recording	10
4	EEG recording demonstration & NIBS stimulation	p/f
5	EEG analysis write up	40

# Overview

- Experimental research design – recap.
- Why computational control?
- Using a software
- Gorilla

# Experimental research design

- Experimental research involves a direct assessment of how one variable influences another
- This allows the **establishment of causality**
- All extraneous variables must be held constant while a single variable is manipulated and the effect measured



# Essential characteristics of experimental research

Control - Manipulation - Observation

# Computational management

- Key tenants of experimental design:
  - Control
  - Manipulation
  - Observation
- All require careful management of stimuli.
- Management of stimuli is most commonly achieved by computer control.

# Exceptions

- Treatment based experimental designs.
  - E.g., Clinical trials.
- Quasi experimental design.
  - Lacking in either randomisation or control.
  - E.g., naturally occurring groups.

# Common cognitive neuroscience designs

- Manipulation of stimuli
  - Where something appears
  - When something appears
  - What it looks like
  - What category it belongs in
- Manipulation of task
  - Attention
  - Memory
  - Working memory
  - Detection/perception





cedrus.



MATLAB

SuperLab

OpenSesame



[www.gorilla.sc](http://www.gorilla.sc)



PsychoPy<sup>3</sup>



**Easy**

enough for teaching

**Precise**

enough for psychophysics

**Flexible**

enough for everything else

**Online**

or lab-based, your choice

**Open Science**

because it's what we do

- PsychoPy<sup>®</sup> is a free cross-platform package allowing you to run a wide range of experiments in behavioural sciences (cognitive neuroscience, psychology, psychophysics, linguistics...)
  - A community-based project.
  - Users have all the source code.
  - Users are the developers.

# PsychoPy for PSY4061

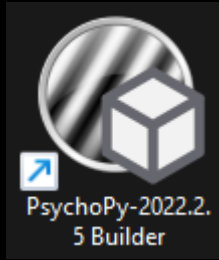


- Graphic User Interface (GUI) or script-based interface.
- Incremental learning approach.
- No code necessary (sort of).
- A gentle introduction to python!

# Teaching a software...?

- Quick and general overview – help you navigate.
- Learn by doing.
- Teaching application of theory.

# PsychoPy Builder



untitled.psyexp - PsychoPy Builder (v2022.2.5)

File Edit View Tools Experiment Demos Pavlovia.org Window Help

Routines

trial x

0 1 2 3 4 5 6 7 8 9 10 11 t (sec)

Components

Favorites

- Keyboard
- Code
- Image
- Mouse
- Sound
- Text

Stimuli

Responses

Custom

EEG

Eyetracking

I/O

Flow

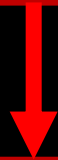
Insert Routine

trial

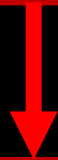
Insert Loop

Detailed description: This image shows the PsychoPy Builder software interface. At the top, there is a menu bar with options like File, Edit, View, Tools, Experiment, Demos, Pavlovia.org, Window, and Help. Below the menu is a toolbar with various icons for file operations and execution. The main workspace is divided into three sections. The top section, 'Routines', shows a timeline from 0 to 11 seconds with a 'trial' routine placed at the beginning. The right section, 'Components', contains a 'Favorites' list with icons for Keyboard, Code, Image, Mouse, Sound, and Text, and a list of other components like Stimuli, Responses, Custom, EEG, Eyetracking, and I/O. The bottom section, 'Flow', shows a flow diagram with a blue box labeled 'trial' connected to an arrow, and options for 'Insert Routine' and 'Insert Loop'.

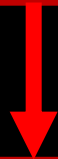
Flow



Routines



Components



Properties

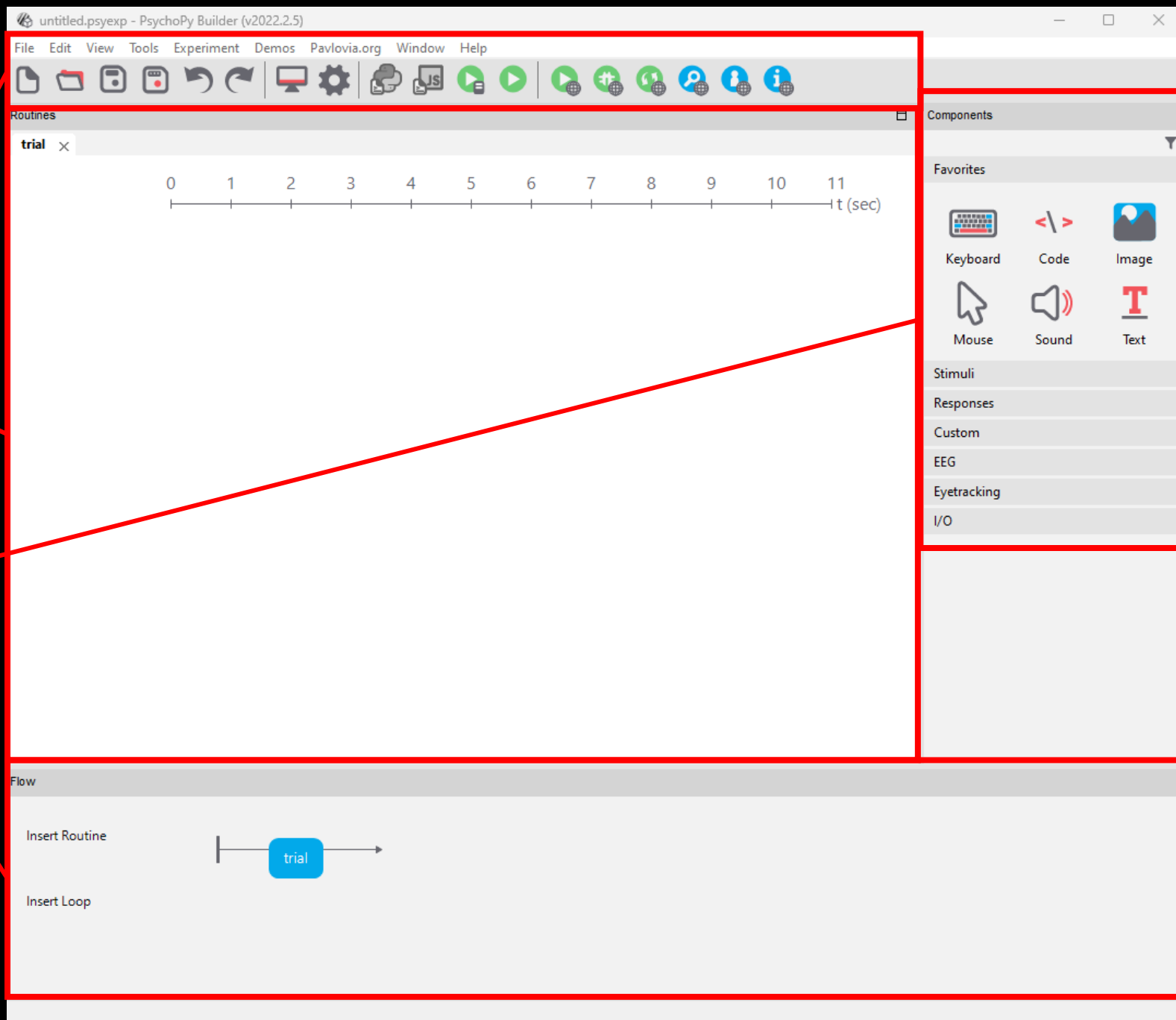
# PsychoPy Builder

Menu bar & buttons

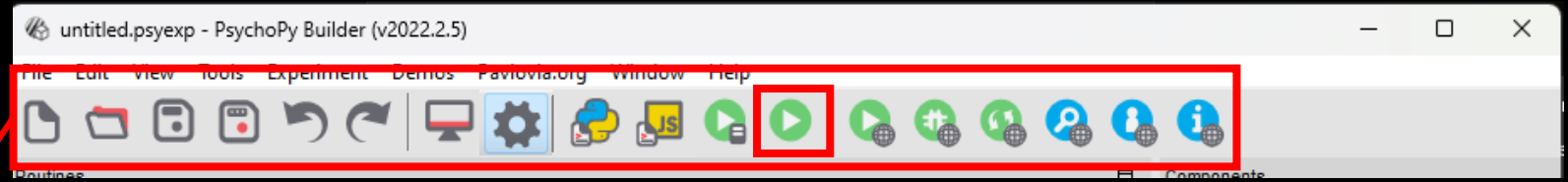
Routine space

Components

Flow space



# PsychoPy Builder



Menu bar & buttons





# PsychoPy Builder

Loop properties

Flow space

The screenshot displays the PsychoPy Builder interface for a routine named 'MentalRotation.psyexp'. The main window shows a timeline from 0 to 1 second with various routine components: 'Instructions\_1', 'Instructions\_2', 'Practice', 'licence', 'pause', 'pause\_start', 'plot\_data\_rt', 'the\_end', and 'trial'. A 'trials Properties' dialog box is open, showing the following settings:

- Name: trials
- loopType: random
- Is trials:
- nReps: 2
- Selected rows: (empty)
- random seed: (empty)
- Conditions: MentalRot.csv
- 16 conditions, with 4 parameters [angle, rightori, leftori, same]

The dialog box has 'Help', 'OK', and 'Cancel' buttons. Below the dialog, the flow space shows a sequence of routine components: 'Instructions\_1', 'Instructions\_2', 'pause\_start (1.50s)', 'trial', 'pause (0.50s)', and 'the\_end'. A mouse cursor is hovering over the 'trial' component, which is highlighted with a red box. The flow space also includes 'Insert Routine' and 'Insert Loop' buttons.

# PsychoPy Builder

Routine space

The screenshot displays the PsychoPy Builder interface for a project named "MentalRotation.psyexp". The main window is titled "Routines" and shows a timeline from 0 to 1 second. Two routines are visible: "instr\_txt\_1" (represented by a blue bar) and "instr\_key\_1" (represented by a yellow bar), both spanning the entire duration. The interface includes a menu bar (File, Edit, View, Tools, Experiment, Demos, Pavlovia.org, Window, Help), a toolbar with various icons, and a right-hand sidebar with "Components" and "Favorites" sections. The "Favorites" section includes icons for Keyboard, Code, Image, Mouse, Sound, and Text. Below the routine space is a "Flow" diagram showing a sequence of routines: "Instructions\_1", "Instructions\_2", "pause\_start (1.50s)", "trial", "pause (0.50s)", and "the\_end". A loop labeled "trials" encompasses the "trial" and "pause" routines.

# PsychoPy Builder

Components

Favorites

Stimuli

Responses












Custom

EEG














Eyetracking

I/O





Stimuli

 Aperture	 Polygon
 Dots	 Env Grating
 Grating	 Image
 Movie	 Noise Stim
 Sound	 Text
 Textbox	

Responses

 Brush	 Button
 Camera	 Keyboard
 Cedrus	 Form
 Io Labs	 Joy Buttons
 Joystick	 Microphone
 Mouse	 Slider
 Textbox	

Custom

 Code	 Resource Manager
 Static	 Variable

MentalRotation.psyexp - PsychoPy Builder (v2022.2.5)

File Edit View Tools Experiment Demo

Routines

0.1

0.7 0.8 0.9 1 t (sec)

Components

Favorites

board Code Image

Sound Text

pause\_start (1.50s) trial pause (0.50s) the\_end

trials

Insert Loop

# PsychoPy Builder

## Component properties

## Components

MentalRotation.psyexp - PsychoPy Builder (v2022.2.5)

File Edit View Tools Experiment Demos Pavlovia.org Window Help

Routines Components

### instr\_txt\_1 Properties

Basic Layout Appearance Formatting Data Testing

Name

Start    
Expected start (s)

Stop   
Expected duration (s)

Text

Welcome. You will see two letters on the screen that have been rotated. For each pair of letters, indicate if they are mirror images of each other when they two letters are in their normal upright position. (Ignore the rotations.)

Press 'm' if they are mirror images of each other.  
Press 'n' if they are not the same (not mirror images).

Press the 'm' to continue.

constant  
set every repeat  
set every frame

Help OK Cancel

Insert Loop trials

the\_end

DON'T  
PANIC

Cod

MentalRotation.psyexp - PsychoPy Builder (v2022.2.5)

File Edit View Tools Experiment Demos Pavlovia.org Window Help

check\_end Properties

Name  Code Type   disabled

Before Experiment Begin Experiment **Begin Routine \*** Each Frame End Routine End Experiment

```
1 # this allows us to end the current task on the nth trial if the participant name was pilot
2 if trials.thisN == 4 and expInfo['participant'] == 'pilot':
3     trials.finished = True
```

Help OK Cancel

Microsoft Excel interface showing the Home tab ribbon and a spreadsheet. The spreadsheet has columns labeled A through J and rows 1 through 19. The data in the spreadsheet is as follows:

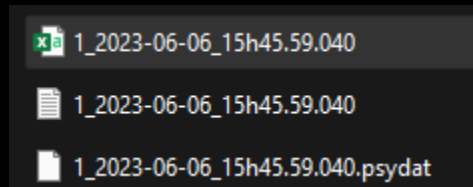
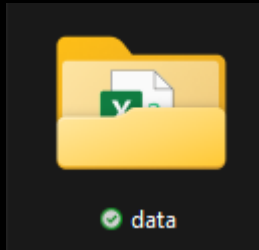
	A	B	C	D	E	F	G	H	I	J
1	leftori	rightori	same	corrAns	angle					
2	0	0	n	n	0					
3	0	0	y	m	0					
4	0	45	n	n	45					
5	0	45	y	m	45					
6	0	90	n	n	90					
7	0	90	y	m	90					
8	0	135	n	n	135					
9	0	135	y	m	135					
10	0	180	n	n	180					
11	0	180	y	m	180					
12	0	225	n	n	225					
13	0	225	y	m	225					
14	0	270	n	n	270					
15	0	270	y	m	270					
16	0	315	n	n	315					
17	0	315	y	m	315					
18										
19										

The ribbon includes: File, Home, Insert, Draw, Page La, Formulas, Data, Review, View, Automa, Develop, Help. The Home tab is active, showing groups for Clipboard, Font, Alignment, Number, Styles (Conditional Formatting, Format as Table, Cell Styles), Cells, Editing, and Analysis. The status bar at the bottom shows 'Ready', 'Accessibility: Unavailable', and '100%' zoom.

Spreadsheet

Background interface showing various icons and controls, including a 'pause' button and a mouse cursor.

# Output files



By default, this is how the output file name is constructed:  
<participant\_ID>\_<experiment\_name>\_<date>\_<time>.csv

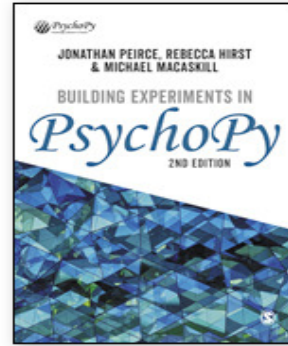
# Getting started with PsychoPy

Download and install standalone package:

<https://www.psychopy.org/download.html>



# Help & support



## Building Experiments in PsychoPy

SECOND EDITION

[Jonathan Peirce](#) - The University of Nottingham, UK

[Rebecca Hirst](#)

[Michael MacAskill](#) - The University of Otago, New Zealand Aotearoa

In the library

- PsychoPy Experiment Recipe Book
  - <https://workshops.psychopy.org/tutorials/index.html>
- Susan Benear's - Coding Outreach Group Summer Workshop – PsychoPy
  - [https://tu-coding-outreach-group.github.io/cog\\_summer\\_workshops\\_2021/psychopy/index.html](https://tu-coding-outreach-group.github.io/cog_summer_workshops_2021/psychopy/index.html)
- PsychoPy Forum – use it, create an account, ask questions and help others.
  - <https://discourse.psychopy.org>

# PsychoPy - citations

- Peirce, J. W., Gray, J. R., Simpson, S., MacAskill, M. R., Höchenberger, R., Sogo, H., Kastman, E., Lindeløv, J. (2019). [PsychoPy2: experiments in behavior made easy](#). *Behavior Research Methods*. 10.3758/s13428-018-01193-y
- Peirce, J. W., Hirst, R. J. & MacAskill, M. R. (2022). [Building Experiments in PsychoPy. 2nd Edn](#) London: Sage.
- Peirce J. W. (2009). Generating stimuli for neuroscience using PsychoPy. *Frontiers in Neuroinformatics*, **2** (10), 1-8. [doi:10.3389/neuro.11.010.2008](#)
- Peirce, J. W. (2007). PsychoPy - Psychophysics software in Python. *Journal of Neuroscience Methods*, **162** (1-2):8-13  
[doi:10.1016/j.jneumeth.2006.11.017](#)