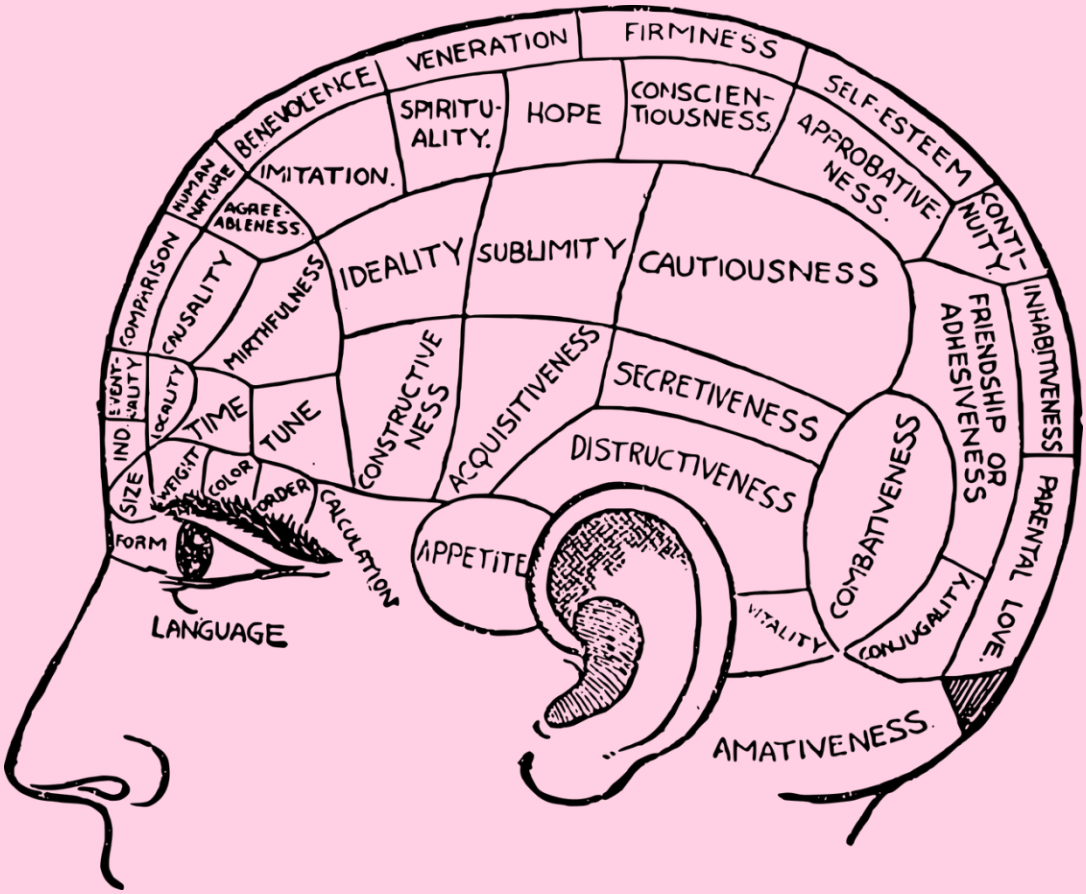
Creating a yes/no recognition memory test using PsychoPy



Adam Pugsley
ajpugsley@myseneca.ca
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Introduction

PsychoPy is an open-source software tool used to create psychology and neuroscience experiments. It is written in the Python programming language and is completely free to use.

PsychoPy is available for download at: https://www.psychopy.org/.

This guide will show you how to create a simple yes/no word recognition memory test using the Builder interface in PsychoPy.

Recognition Memory

Recognition memory is function of human psychology that allows the brain to recognize information that has been seen before. For example, when you recognize the face of someone you know, you are using recognition memory.

For recommended readings, see Table 1.

Yes/no recognition tests

One of the simplest ways of testing recognition memory is a yes/no recognition test.

In a yes/no recognition test, participants are:

1. Shown several words or images.
2. Shown the items again after a brief period, this time mixed in with new items.
3. Asked if they recognize the items.

This type of yes/no recognition test allows you to determine the accuracy of a participant's recognition memory.

PsychoPy

PsychoPy makes it easy for anyone to create a yes/no recognition memory test.

There are two main interfaces for creating experiments in PsychoPy: Builder and Coder. This guide will use the Builder interface exclusively.

PsychoPy Builder

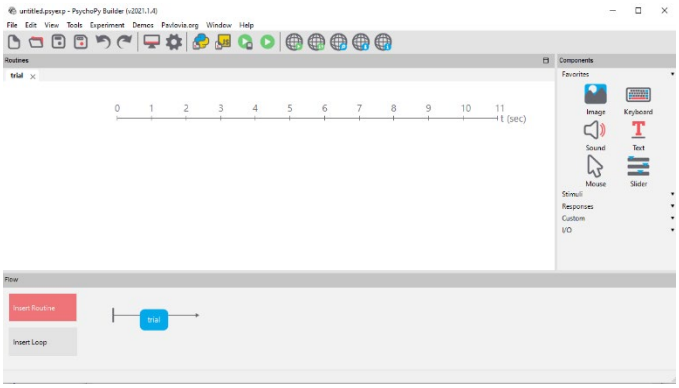

Figure 1: A blank Builder interface

Builder is PsychoPy's graphical user interface for designing experiments.

There are three main panels in the Builder interface:

- Routines
- Components
- Flow

Routines panel

The Routines panel displays a timeline of the currently selected Routine and the Components that make up that Routine.

Routines specify the timing of events and/or elicit responses from the participant. Within a Routine, events from the Components panel can be added to a timeline.

Components panel

The Components panel allows you to browse Components and add them to a Routine. There are two types of Components:

- **Stimuli**: allow you to present participants with visual or auditory information.
- **Responses**: allow you to record participant's responses to Stimuli.

Flow panel

The Flow panel allows you to organize your Routines and determine the order in which they are presented to participants.

The Flow panel also allows you to create Loops that repeat Routines.

Creating a yes/no recognition memory test

To create a yes/no recognition memory test in PsychoPy, there are three main steps:

1. Create a word list in Excel
2. Create a study trials Loop
3. Create a test trials Loop

Creating a word list in Excel

To present participants with words, you must create a word list in Excel. PyschoPy will use this Excel file to draw words from.

Choosing words

Begin by choosing the words you want your participants to see. You can either come up with them yourself or use a random word generator such as https://randomwordgenerator.com/.

The number of words in your word list will vary depending on your needs. However, your word list must contain twice the number of words that you want your participants to study.

Example Words:

- Horse
- Effort
- Beach
- Deer
- Camp
- Rob
- Energy
- Harm

For example, if you have 10 words that you want your participants to try to remember, then create a word list containing 20 words.

Adding words to Excel

Once you have chosen words to add to your word list, it is time to create a word list in Excel.

1. Open a blank Excel workbook.
2. In cell A1, create a heading titled **Words.**
3. Below the heading, insert your words into **column A.**
4. Save the workbook in memorable location.

	A	B	C	D	E	F
1	**Word**					
2	Horse					
3	Effort					
4	Beach					
5	Deer					
6	Camp					
7	Rob					
8	Energy					
9	Harm					
10	File					
11	Ash					

Figure 2: A word list in Excel

You now have a word list in Excel that will be used by PsychoPy and displayed to participants.

Creating the study trials Loop

It is now time to use the PsychoPy Builder to begin designing your experiment. The study trials Loop is the part of the experiment where participants will study the words you have chosen for them to remember.

Creating the welcome screen

The first step in creating a study trials Loop is creating a welcome screen to greet participants.

Creating the welcome text

1. In the Flow panel, right click on the default trial and select **remove**.

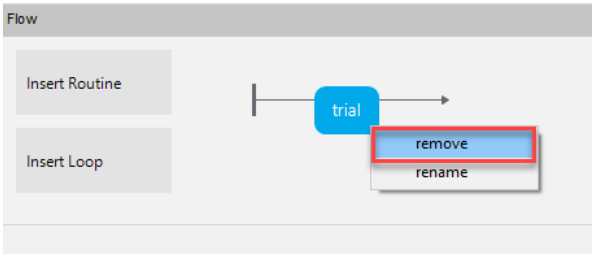

Figure 3: Removing the default Routine

2. In the Flow panel, select **Insert Routine** and select **(new)** from the dropdown menu.
3. Name the new Routine **Welcome** and select **OK.**
4. In the Flow panel, select the **black circle** to insert the new Routine on the timeline.

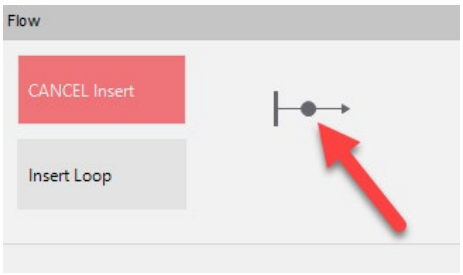

Figure 4: Inserting the welcome screen Routine

5. In the Routines panel, select the **Welcome** tab on the top of the panel to view the new Routine.
6. In the Components panel, select **Text.**
7. In the Name box of the text Properties window, type **WelcomeText**.

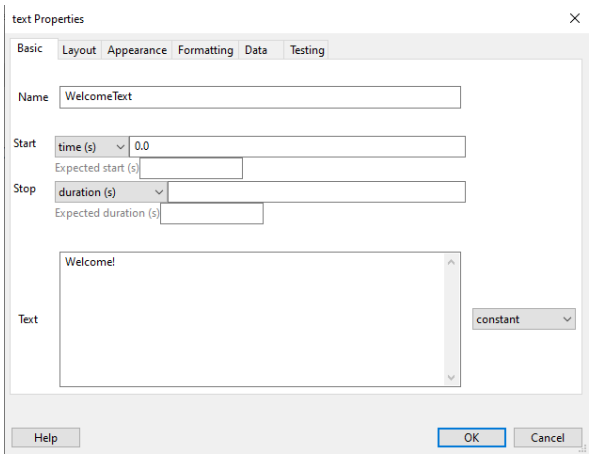

Figure 5: The completed text Properties window

8. Remove the default duration of 1.0(s) in the **Stop** box and leave the box blank. This creates an endless duration.
9. In the **T**ext box, type **Welcome!**
10. Select **OK** to create the new WelcomeText Component.

Creating the welcome key response

1. In the Components panel, select **Keyboard**.
2. In the Name box of the key_resp Properties window, type **WelcomeKey.**
3. In the Allowed keys box, remove the default values and type **'space'**.
4. Select **OK** to create the new WelcomeKey Component.

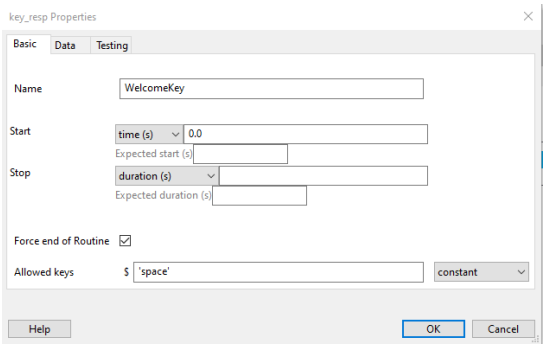

Figure 5: The completed key_resp Properties window

You now have a welcome screen Routine that ends when the space bar is pressed.

Creating the trials Loop

The trials Loop is the part of your experiment where participants will study the words you have chosen for them.

Creating the text display

1. In the Flow panel, select **Insert Routine** and select **(new)** from the dropdown menu.
2. Name the new Routine **StudyWord** and select **OK.**
3. In the Flow panel, select the **black circle** to the right of the Welcome Routine to insert the new Routine to the timeline.
4. In the Routines panel, select the **StudyWord** tab to view the new Routine.
5. In the Components panel, select **Text.**
6. In the Name box of the text Properties window, type **WordItem**.
7. In the Start box type **0.5**.
8. In the Stop box type **2.0**. This will display the word on screen for 2 seconds.
9. In the Text box type **$Word**.

Note: you can also view a Routine by selecting the Routine in the Flow panel.

Note: This is used to link your word list Excel file to the PsychoPy Builder.

10. Select **OK** to create the new Word Component.

Creating the fixation point

1. In the Components panel, select **Text.**
2. In the Name box of the text Properties window, type **FixationPoint**.
3. In the Start box type **0.0**.
4. In the Stop box type **0.5**.
5. In the Text box type **+**.
6. Select **OK** to create the new FixationPoint Component.

Creating the Loop

1. In the Flow panel, select **Insert Loop.**
2. Select the **black disk to the right** of the StudyWord Routine, and then select the **black disk to the left** of the StudyWord Routine.

Figure 5: Inserting the study trials Loop

3. In the Name box of the Loop Properties window, type **StudyTrials**.
4. In the nReps box, type **1.**
5. Select the **Specify File** button to the right of the Conditions box.

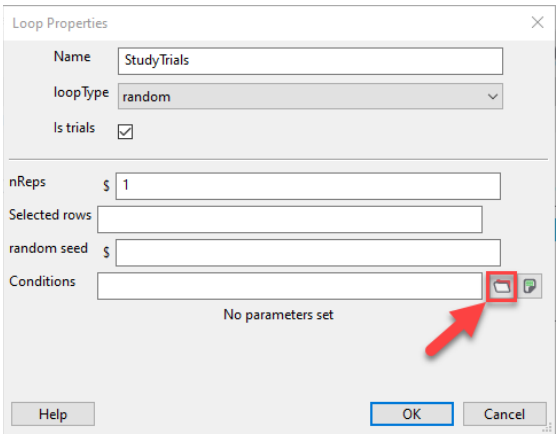

Figure 6: Selecting the Specify File button

6. Navigate to your word list Excel file and select **OK**.

Note: You should now see text indicating the number of conditions (words) in your word list, as well as one parameter called Word.

7. In the Selected rows box, indicate the words from your word list that you want participants to study by typing a subset of rows for your word list file.

Note: You should present participants with half of the total number of words in your word list. The first row is 0, not 1.

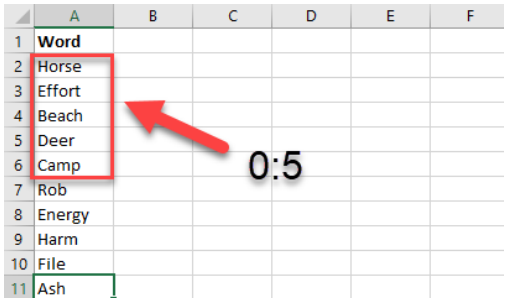

Figure 7: Selected words from the word list and the corresponding **Selected rows** input.

8. Select **OK** to close the Loop Properties window.

Linking your word list Excel sheet

1. In the Routines panel, select the **WordItem Component** in the StudyWord Routine.
2. In the Text box, replace “Word goes here” with **$Word**.
3. From the dropdown menu to the right of the Text box, select **set every repeat**.
4. Select **OK** to close the WordItem Properties window.

You now have a functioning study trials Loop displays words from your word list with a 500ms fixation point between each word.

Creating the filler task screen

It is ideal to have participants complete an unrelated filler task for a brief period before testing their memory. This ensures that they are not rehearsing the words in their mind before being you test them.

The filler task will vary in nature and length depending on your needs. For example, you might have your participants complete an easy arithmetic game for two minutes.

While your participants are completing the filler task, PsychoPy can display a message on screen.

Creating the filler text

1. Select **Insert Routine** from the Flow panel and select **(new)** from the dropdown menu.
2. Name the Routine **FillerScreen** and select **OK.**
3. In the Flow panel, select the **black disc** to the right of the StudyTrials Loop to insert the FillerScreen Routine to the timeline.
4. In the Routines panel, select the **FillerScreen tab** to view the new Routine.
5. In the Components panel, select **Text**.
6. In the Name box of the text Properties window, type **FillerText**.
7. Remove the default duration of **1.0(s)** in the Stop box and leave the box blank.
8. In the Text box type **Please see the researcher for instructions.**
9. Select **OK** to create the new FillerText Component.

Creating the key response

1. In the Components panel, and will the FillerScreen Routine tab open, select **Keyboard.**
2. In the Name box of the key_resp Properties window, type **FillerKey.**
3. In the Allowed keys box, remove the default values and type **‘space’**.
4. Select **OK** to create the new FillerKey Component.

You now have a filler screen Routine that ends when the space bar is pressed.

Creating the test trials Loop

It is now time to create the recognition memory test. Participants will be shown all the words in your word list and asked whether they remember the word.

Creating the test text display

1. In the Flow panel, select **Insert Routine** and select **(new)** from the dropdown menu.
2. Name the new Routine **TestWord** and select **OK.**
3. In the Flow panel, select the **black circle** to the right of the FillerScreen Routine to insert the new Routine to the timeline.
4. In the Routines panel, select the **TestWord tab** to view the Routine.
5. In the Components panel, select **Text.**
6. In the Name box of the text Properties window, type **TestWordItem**.
7. Remove the default duration of **1.0(s)** from the Stop box and leave the box blank.
8. In the Text box, type **$Word.**
9. From the dropdown menu to the right of the Text box, select **set every repeat**.
10. Select **OK** to close the text Properties window.

Creating the test key response

1. In the Components panel, and with the TestWord Routine tab open, select **Keyboard.**
2. In the Name box of the key_resp Properties window, type **TestKey.**
3. In the Allowed keys box, remove the default values and type **'y','n'.**
4. Select **OK** to create the new TestKey Component.

Creating the Loop

1. In the Flow panel, select **Insert Loop.**
2. Select the **black disk to the right** of the TestWord Routine, and then select the **black disk to the left** of the TestWord Routine.
3. In the Name box of the Loop Properties window, type **TestTrials**.
4. In the nReps box, type **1.**
5. Select the **Specify File** button to the right of the Conditions box.
6. Navigate to your word list Excel file and select **OK**.

Note: Leave the Selected rows box blank. Unlike when you created the StudyTrials Loop. you should now present participants with all the words in your word list.

7. Select **OK** to close the Loop Properties window.

You now have a test trials Loop that presents participants with all the words from your word list and records their responses to each word.

When testing, instruct your participants to press the **y key** if they remember the word from the study trials, or press the **n key** if they do not.

PsychoPy will record their responses to each word and save them in an Excel file for you to analyze.

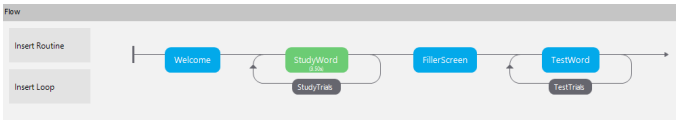

Figure 8: The finished experiment Flow

Running the yes/no recognition memory test

You now have a working yes/no recognition memory test!

To run the experiment, select the green **Run experiment** button in the PsychoPy Builder toolbar and type a participant number.

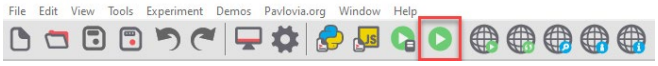

Figure 9: The Run experiment button

Tables

Table 1

Recognition Memory Papers

Title	Author(s)	Citation
Measuring recognition memory	Wayne Donaldson	Donaldson, Wayne. "Measuring recognition memory." *Journal of Experimental Psychology: General* 121.3 (1992): 275.
Retrieval processes in recognition memory	Roger Ratcliff & Bennet B. Murdock	Ratcliff, Roger, and Bennet B. Murdock. "Retrieval processes in recognition memory." *Psychological review* 83.3 (1976): 190.
Human recognition memory: a cognitive neuroscience perspective	Michael D. Rugg & Andrew P. Yonelinas	Rugg, Michael D., and Andrew P. Yonelinas. "Human recognition memory: a cognitive neuroscience perspective." *Trends in cognitive sciences* 7.7 (2003): 313-319.
Recognition memory for words, sentences, and pictures	Roger N. Shephard	Shepard, Roger N. "Recognition memory for words, sentences, and pictures." *Journal of verbal Learning and verbal Behavior* 6.1 (1967): 156-163.
Recognition memory and the medial temporal lobe: a new perspective	Larry R. Squire, John T. Wixted and Robert E. Clark	Squire, Larry R., John T. Wixted, and Robert E. Clark. "Recognition memory and the medial temporal lobe: a new perspective." *Nature Reviews Neuroscience* 8.11 (2007): 872-883.