



Free and open-source software
in laboratory and online research
in experimental psychology

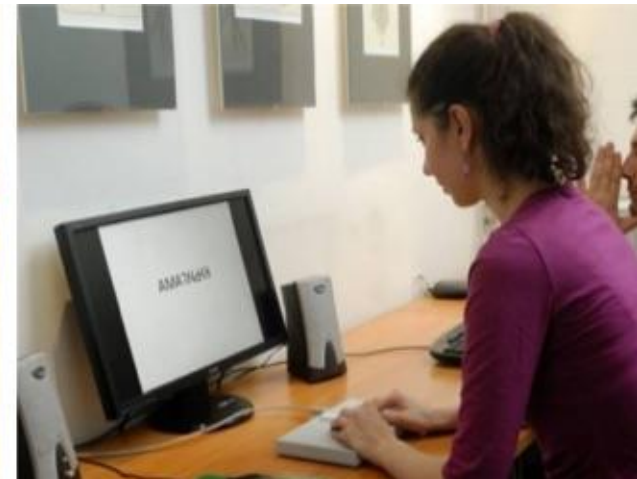
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Experimental psychology

- A branch of psychology
 - Using experimental method
 - In the study of psychological processes
- Defined by method!
 - Experimental cognitive psychology
 - Experimental social psychology
 - Experimental clinical psychology



Experimental psychology

- The need for
 - Precise control of stimuli presentation

**MNEMOMETER,
AFTER RANSCHBURG**
(E. Zimmermann, Leipzig – Berlin)



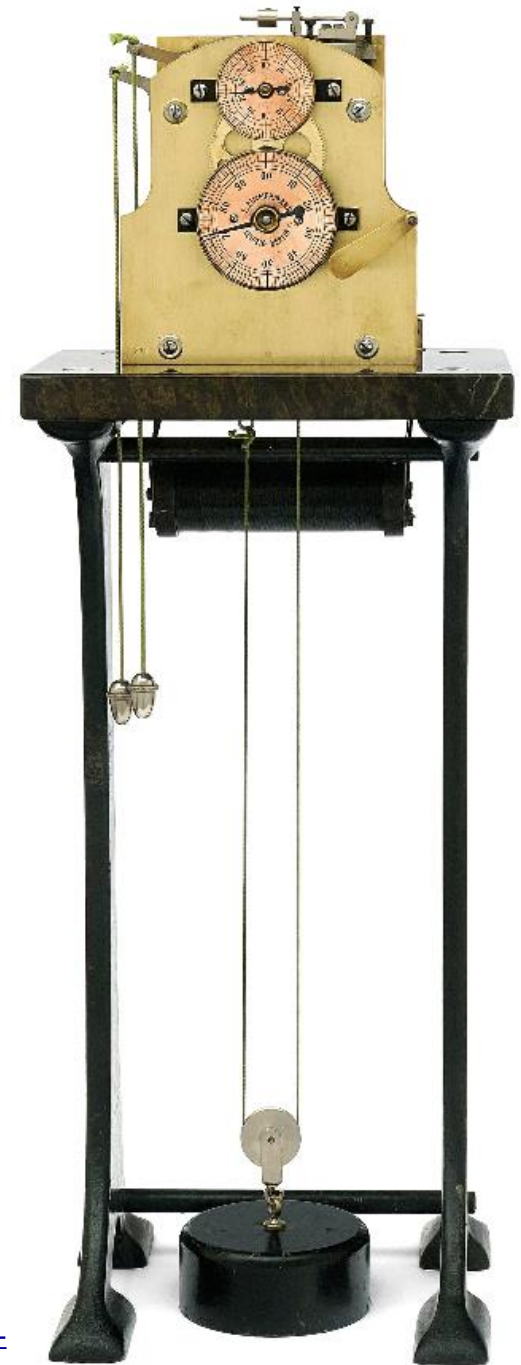
Experimental psychology

- The need for
 - Precise timing of responses

CHRONOSCOPE WITH POLARIZED MAGNET, AFTER SCHULZE

(E. Zimmermann, Leipzig – Berlin)

<http://lep.rs/en/about-us/the-collection-of-old-scientific-instruments/instruments-for-investigating-cognitive-processes/chronoscope-with-polarized-magnet-after-schulzee-zimmermann-leipzig-berlin/>

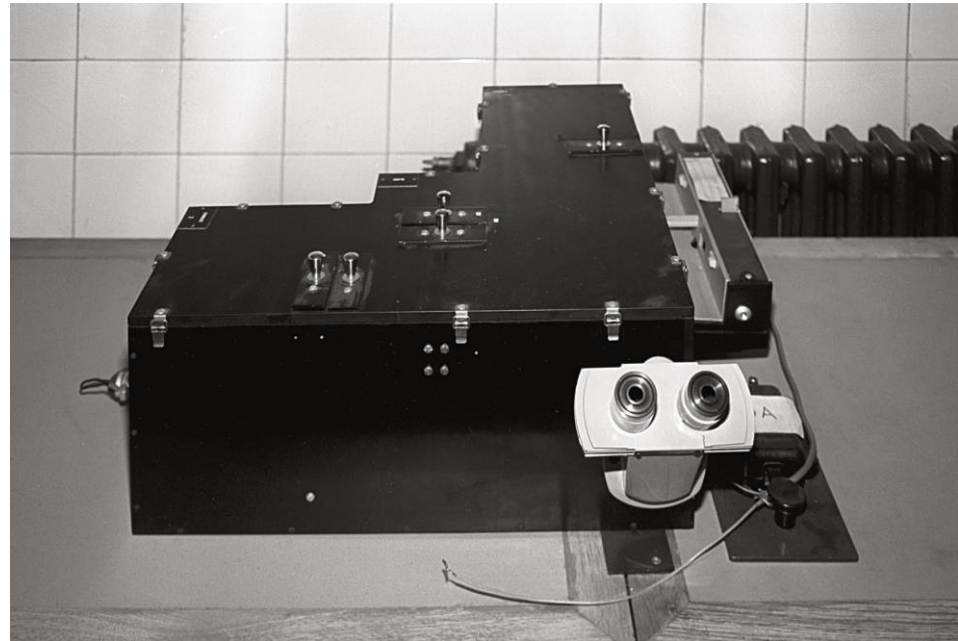


Tachistoscope



Tachistoscope

- Precise but time consuming!



Computer-aided experiments in the 80's

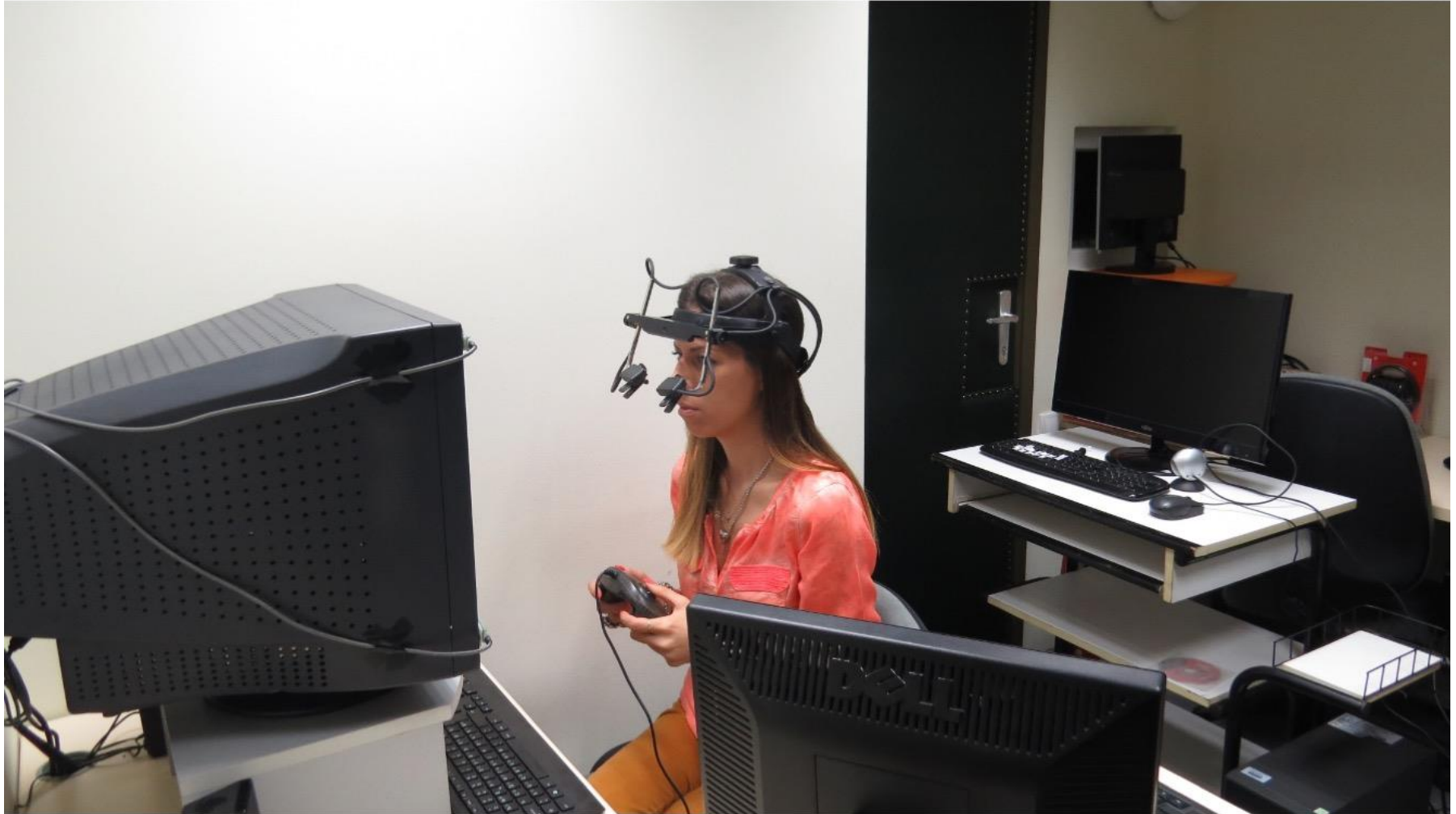


Computer-aided experiments today



<http://lep.rs/en/about-us/brief-history/the-last-two-decades/#gal>

Computer-aided experiments today



<http://lep.rs/en/about-us/brief-history/the-last-two-decades/#gal>

The most popular commercial software

- Typically:
 - Graphical User Interface
 - Precise control over stimuli display
 - Text, Sound, Image, Video...
 - Precise measurement of the response timing
 - Coupling with EEG, fMRI, EyeTracker...
 - Templates
 - Tutorials
- But
 - Expensive
 - Important things hidden from the user

- E-Prime
- Presentation
- SuperLab
- Experiment Builder
- Inquisit
- DirectRT

The researchers strike back

- Writing open code for their own research and sharing with the community
 - The growing community
 - Forums
 - Tutorials
 - Templates
 - Graphic User Interface
- The code built by the scientists to fit the needs of the scientists
 - Quickly adapting

Free software

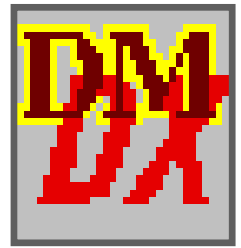
- DMDX
- PsychoPy
- OpenSesame

- VideoToolbox
- PsychToolbox/MATLAB
Psychophysics Toolbox
- PEBL
- PyScope za Mac OS
- PsyToolkit za Linux
- Tscope
- Vision Egg
- Tatool
- ExpFactory
- NodeGame

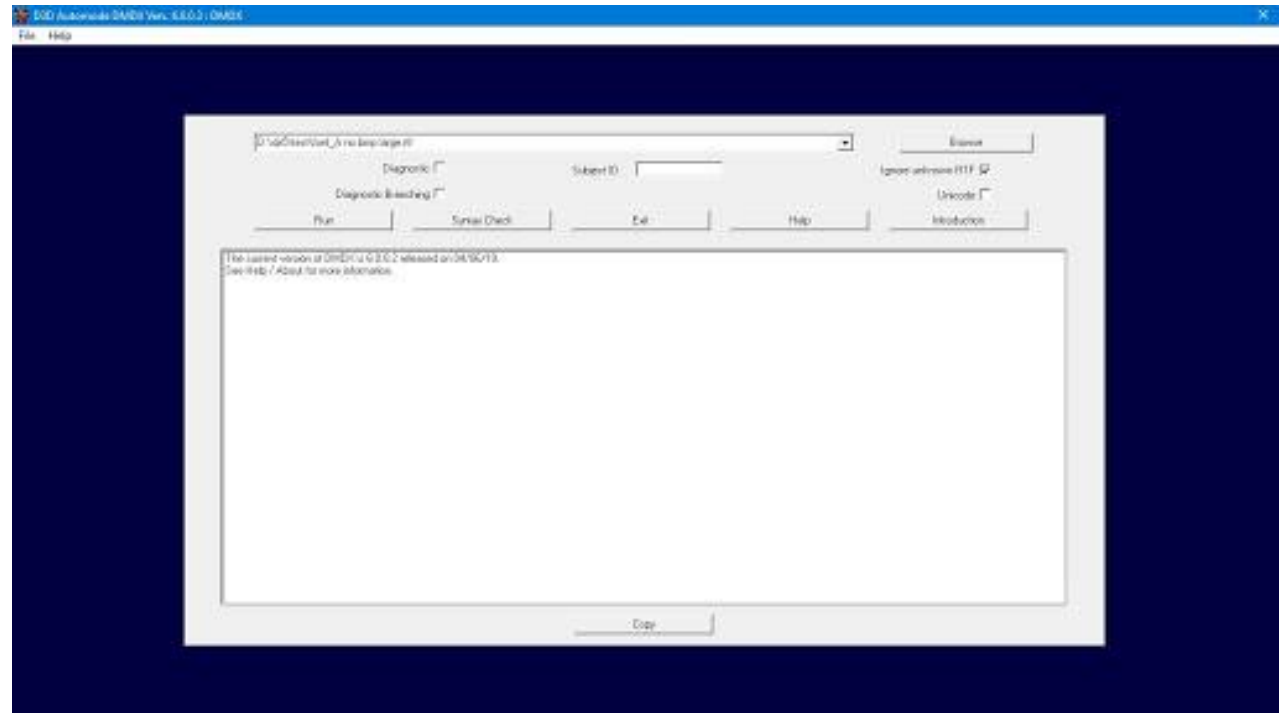
- UltraLab



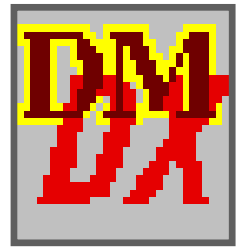
DMDX



- Started in 1975
- Maintained to date
- High precision in stimuli presentation timing



DMDX item file (script)



- Header line
 - global parameters (screen color, response keys, number of stimuli...)
- Item lines
 - description of pseudotrials – instructions to be presented
 - description of trials – WYSIWYG, timing, correct response...

A screenshot of the LibreOffice Writer application window. The title bar reads "Dusica.WSE1_A.rtf - LibreOffice Writer". The menu bar includes "File", "Edit", "View", "Insert", "Format", "Table", "Tools", "Window", and "Help". The toolbar shows various icons for editing and formatting. The main text area contains a DMDX script file with the following content:

```
<n 240> <s 80> <d 30> <azk> <cr> <nfb> <clfb> <id "keyboard"> <id "mouse">
<dbc 0> <dwc 192192192> <vm 1280,800,800,32,60> <t 3000>

$
0 "Pritisnite široku tipku za početak vežbe.";
$

$
-315 <fd 30>/ <fd 30> "."/ <fd 3> "GHTČS"/ <fd 12> "*****" / <fd 16> / *<ln
-1>" C", <ln 0> "*****", <ln 1> " S";
-301 <fd 30>/ <fd 30> "."/ <fd 3> "SCENA"/ <fd 12> "*****" / <fd 16> / *<ln
-1>"o ", <ln 0> "*****", <ln 1> "s ";
+307 <fd 30>/ <fd 30> "."/ <fd 3> "ZATRA"/ <fd 12> "*****" / <fd 16> / *<ln
-1>" A ", <ln 0> "*****", <ln 1> " E ";
-306 <fd 30>/ <fd 30> "."/ <fd 3> "SCEFA"/ <fd 12> "*****" / <fd 16> / *<ln
-1>"o ", <ln 0> "*****", <ln 1> "s ";
-316 <fd 30>/ <fd 30> "."/ <fd 3> "o "/ <fd 12> "*****" / <fd 16> / *<ln
-1>"s ", <ln 0> "*****", <ln 1> "o ";
-311 <fd 30>/ <fd 30> "."/ <fd 3> "OHGTR"/ <fd 12> "*****" / <fd 16> / *<ln
-1>"s ", <ln 0> "*****", <ln 1> "o ";
-305 <fd 30>/ <fd 30> "."/ <fd 3> "TALAC"/ <fd 12> "*****" / <fd 16> / *<ln
-1>" S", <ln 0> "*****", <ln 1> " C";
-314 <fd 30>/ <fd 30> "."/ <fd 3> "BCMTB"/ <fd 12> "*****" / <fd 16> / *<ln
-1>" G ", <ln 0> "*****", <ln 1> " T ";
+317 <fd 30>/ <fd 30> "."/ <fd 3> " E "/ <fd 12> "*****" / <fd 16> / *<ln
```

The status bar at the bottom shows "Page 1 / 10", "Words: 7265", "Default Style", "Polish", and a zoom level of "123%".

PsychoPy

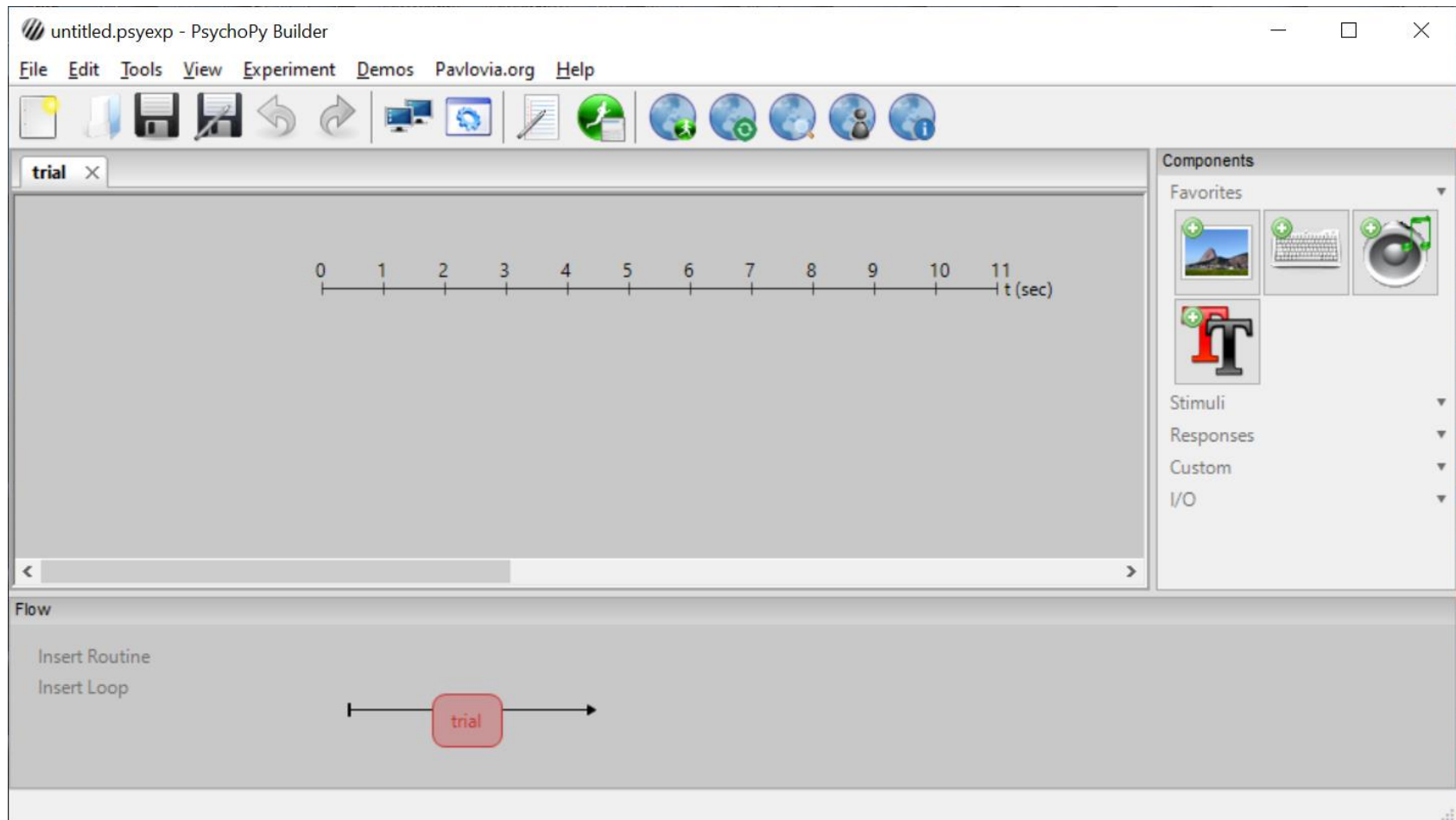
- Python library for controlling stimuli presentation and response collection
- Since 2002
- The goal:
 - To make the best out of power and simplicity



PsychoPy Builder



- Graphical interface

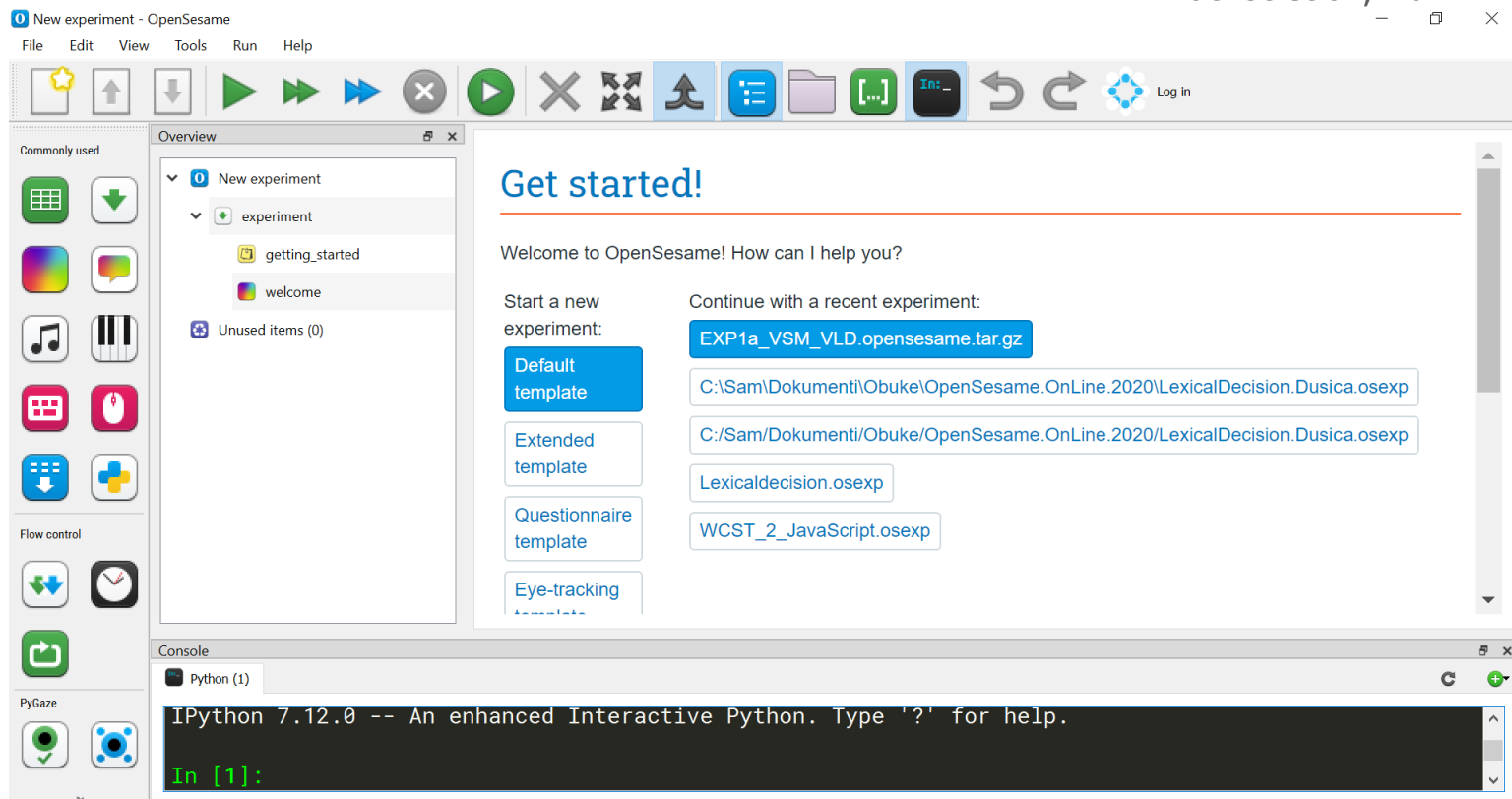




OpenSesame

- Also based on the PsychoPy library
- Also has Graphical User Interface
 - Built in parallel with PsychoPy Builder

Mathot et al., 2012



OpenSesame



- Instruction can be inserted using GUI
 - Simplicity

OpenSesame



- Instructions can be written in the inline script

The screenshot displays the OpenSesame software interface. At the top, the file path is shown as "C:/Sam/Dokumenti/Eksperimenti_mojj/EXP.MAJ2017.NS/doexp1/POLIS_A_mis.opensesame.tar.gz * - OpenSesame". The main window is titled "meta_exp - sketchpad" and contains an inline script editor with the following code:

```
1 set duration 0
2 set description "Displays stimuli"
3 draw textline center=1 color=grey font_bold=no font_family=mono
  font_italic=no font_size=40 html=yes show_if=always text="[rec]" x=0
  y=0 z_index=0
4
```

The interface also features a left sidebar with various tool icons, an "Overview" panel showing a hierarchical tree of the experiment structure (including "POLIS_A", "experiment", "vezba_loop_1", "vezba_sequence", "ft_exp", "meta_exp", "_mouse_response", "exp_logger", "pocetak_eksperimenta", "exp_loop_1", "exp_sequence", "ft_exp", "meta_exp", and "_mouse_response"), and a "Console" panel at the bottom with a "Python (1)" tab.

OpenSesame



- And also in Python
 - Flexibility

The screenshot displays the OpenSesame software interface. The main window is titled "select_response_card – inline script" and shows a Python script for executing code. The script is as follows:

```
1 overlap1 = 2
2 overlap2 = 2
3 overlap3 = 2
4 overlap4 = 2
5 while overlap1 > 1 or overlap2 > 1 or overlap3 > 1 or overlap4 > 1:
6     var.response_shape = random.choice(['circle', 'cross', 'star', 'triangle'])
7     var.response_color = random.choice(['red', 'blue', 'yellow', 'green'])
8     var.response_number = random.choice([1, 2, 3, 4])
9     overlap1 = (
10         (var.response_shape == var.shape1) +
            (var.response_color == var.color1) +
```

The interface includes a menu bar (File, Edit, View, Tools, Run, Help), a toolbar with various icons, and a sidebar with "Commonly used" and "Flow control" sections. The "Overview" panel on the left shows a tree view of the experiment structure, including "instructions_sequence" and "block_loop". The "Console" panel at the bottom shows a Python (1) session.

Lab-to-web transition

- WEIRD population of participants
 - Western
 - Educated
 - Industrialized
 - Rich
 - Democratic

Henrich, Heine, & Norenzayan (2010)

- SARS-COV2

Popular commercial software for online data collection

- Qualtrics
- Gorilla
- Inquisit Web

Online research



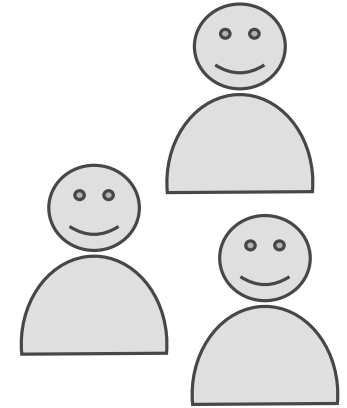
Challenge #1

How to conduct the experiment on different computers?



Challenge #2

How to store data and distribute the experiment?



Challenge #3

How to recruit the participants?

Online research



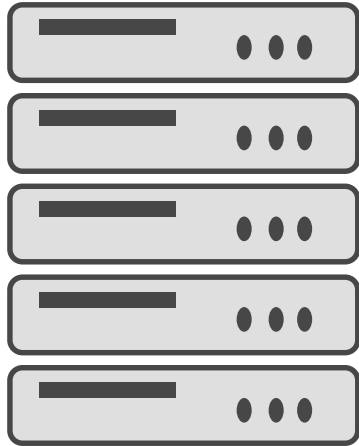
Challenge #1

How to conduct the experiment on different computers?

- The stimuli are presented in the browser
- The instructions are downloaded
 - The code in
 - JavaScript
 - HTML
 - CSS



Online research



Challenge #2

How to store data
and distribute the
experiment?

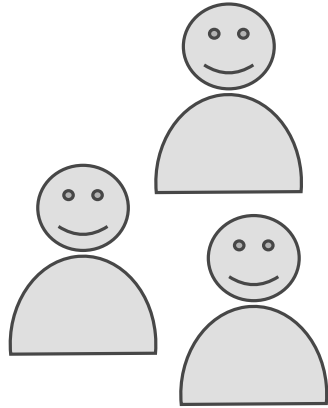
- The code is stored on the server
- The controlled link is prepared for the participant
 - Individual/group links
 - Single/multiple access
- The collected data is stored on the server



Cognition.



Online research



Challenge #3

How to recruit
the participants?

- Distributing the links
 - Crowdsourcing platforms

- Paying for participation

amazon mechanical turk

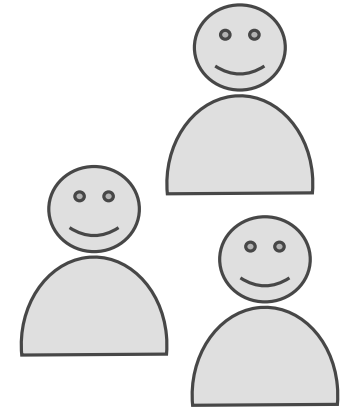


- Social media

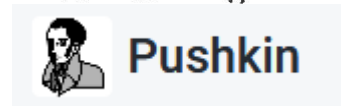
- Online quizzes

- Test my brain
 - Small world of words
 - Games with words
 - The music lab
 - Lab in the wild

Online research. Covered.



Cognition.



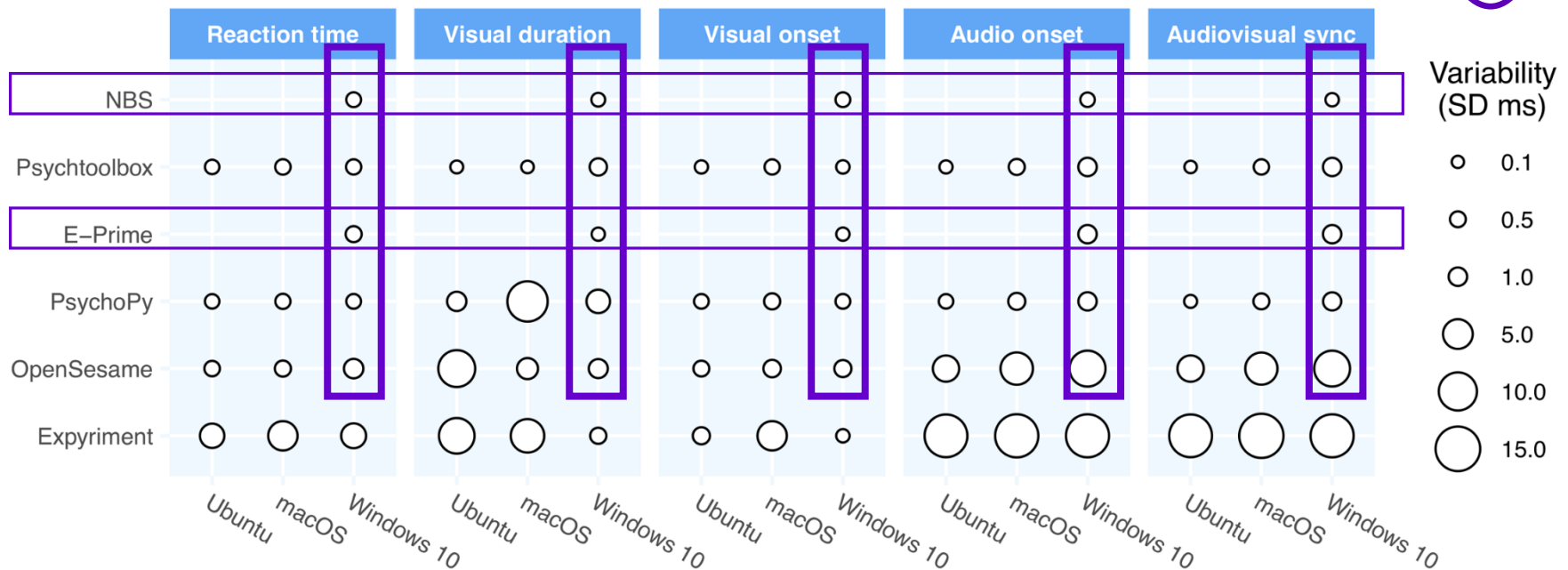
Commercial vs. Free software

- Issues in chronometric studies
 - Accuracy
 - A fixed error, e.g. a lag
 - Solved by taking the lag into account, using repeated measures
 - Precision
 - Variable trial-by-trial error of unknown size
 - Impossible to fix
- Who wins in terms of precision?

Precision in the lab

- Impressive for most packages
 - Sub-millisecond precision
 - For both commercial and free packages

Package	Platform	Mean precision (ms)
PsychToolBox	Ubuntu	0.18
Presentation	Win10	0.29
PsychToolBox	macOS	0.39
PsychoPy	Ubuntu	0.46
E-Prime	Win10	0.57
PsychToolBox	Win10	0.67
PsychoPy	Win10	1.00



Precision online



To conclude

- Free/open software for conducting psychological experiments
 - Has all of the benefits of the commercial software
 - Precision
 - Reliability
 - Simplicity
 - Support (forums, tutorials)
 - And some additional benefits as well
 - It is free (in many ways)
 - It is transparent
 - It is flexible and adaptive

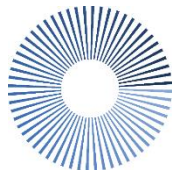


THANK YOU!

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<http://lep.rs/en/associates/dusica-filipovic-durdevic/>
https://www.f.bg.ac.rs/psihologija/zaposleni_od?IDZ=935
https://www.f.bg.ac.rs/cv/FIDU_935.pdf
[@dfdurdevic](#)

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