E-prime: A quick & dirty guide

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With help from Paul Jackson
What is Eprime?

- Eprime is a software tool for presenting stimuli under precise timing
- and collecting reaction time and accuracy data for simple responses to the stimuli
- Especially useful for reaction time experiments or when events are presented rapidly, or when stimuli have a very brief duration.
- It could be used for collecting ratings of pictures, answers to questionnaire items, etc
  - Though specialist survey tools probably work better for self-report studies in social, clinical, organisational.
Why do you need Eprime to get RT?

- Reaction times (RTs) are measured in milliseconds (ms) – 1/1000 second.
- Computers have clocks at ms accuracy, so why not use an ordinary computer program?
- Because the operating system (Windows) - not the program - controls when the clock is checked and when response inputs are looked for.
- Timing how soon after an event a person presses a key on the keyboard
  - Several hundred ms may go by before key-presses are checked
  - And the delay is unknown and varies unpredictably!
Ms timing accuracy

- The same issues apply to presenting visual and auditory stimuli at precise times
- With CRT monitors (not flat screens), it is possible to synchronise visual stimulus displays with the refresh rate of the screen
- Eprime and specialised experimental control applications do this
- Run your monitor at a high refresh rate (85 – 120 Hz) and make sure it doesn’t change during the experiment!
- Also keep constant the screen resolution, contrast, vertical/horizontal alignment, etc.
Monitors & refresh rates

- The screen refresh rate = the number of times per second that the screen display can be changed
  - 85 Hz means 85 refreshes per second
- So $1000/85 = 11.8$ ms to set the pixels for a display
  - This limits the *minimum duration* of any visual display to about 12 ms.
- ALSO, longer stimulus durations will be in multiples of 11.8 ms.
  - So you can have displays of 12 or 260 ms; but not 15 or 125 ms.
- NB: Eprime will give you at LEAST the duration specified, so not necessarily the closest duration
- If you want 24 ms, ask for say 20 ms, NOT 25 ms
Equipment & timing accuracy

- Flat screens have different technology (LCD – liquid crystal displays)
  - There is a problem for real-time control because the screen may not refresh when the video card issues the instruction
  - Eprime can only access the instruction from the video card
- Some LCDs are very slow and there may be problems with clarity of stimuli viewed from an angle
- Eprime will run on LCDs, and new LCDs are fast, but get advice if precise timing is an issue
  - i.e., 10 – 20 ms accuracy in the display or RTs
- If you need precise timing for auditory stimuli, you need to use a sound card recommended by Eprime
Equipment and timing accuracy: Response devices

- The keyboard is OK to use with Eprime but probably produces poorer RT precision than a special purpose response box.
- The school has 2-button boxes designed to connect with inputs to the PC that are rapidly detected.
  - Other devices may be used by your supervisor.
- Vocal response RTs can be detected by the button box – insert the microphone input into the button box.
- Note that the box merely detects a switch closure when the microphone is activated, so Eprime can’t score responses.
- If you also wish to store what was said, you can have the computer record for you. otherwise, you can record it manually.
Eprime vs. other software tools for experiments

- NOTE that Eprime runs only on PCs – use Matlab or other for macs
  - Note that macs are often used in perception experiments for their good displays, colours, etc.
- Of other applications, Presentation is very good and more powerful than Eprime – but also quite difficult to learn if you have no programming background.
- Eprime probably is the easiest to use, and is available on all PCs in bookable labs
- If you need Eprime for an experiment, see Paul Jackson (School IT staff, here Mon & Thurs)
  - The School has a site licence
Eprime: What can it do?

Eprime is ideal if:

- You want to present a series of stimuli and get a response to one (or more) before the next stimulus is presented
- Responses can be a single button press or microphone activation,
- Or a series of responses from a single device
  - e.g., typing letters of a word

Examples:

- Lexical decision (LDT), word naming, colour naming, all kinds of decisions such as same/different, left/right, old/new, happy/sad, target identification in RSVP, letter identity in visual search, digit span, operation span, etc
Masked priming in LDT

Participant sees: &&&&& GHOST
Masked priming in LDT

3 objects in Eprime
Part of a trial procedure

GHOST

&&&&
ghost

&&&&
GHOST

500 ms
60 ms
time
Eprime 1 vs. 2

- The appearance (icons, colours, layout) may be a bit different depending on whether you have Eprime 1 or 2
- Functions are basically the same
- Open an E-studio file to create an experiment
  - e.g., LDT.es
- The E-studio file has an icon with green cubes
Eprime objects

- **Display** objects
  - text objects, slide and image objects for text, sounds (wav) or imported pictures

- **List** objects
  - For lists of trial stimuli, list of blocks, etc.

- **Procedure** objects
  - The strict sequence of events for parts of the experiment – whole experiment, tasks, phases, blocks, individual trials

- **Feedback** objects
  - Indicate on the screen after each response whether it was correct, fast/slow enough.

- **Timer** objects
Eprime 2: Toolbox and objects

- **Text display:**
  - Instructions, text and word stimuli, digits, “take a rest break”, etc.

- **Slide:**
  - Allows presentation of pictures, sound files, bitmap diagrams, etc.
    - Also text
    - Drag SoundOut onto slide to add sound
    - Can edit each part of the slide separately
      - e.g., to have a word on the left and picture on right
Toolbox and workspace

- In E-studio, the default layout has the objects of the toolbox down the left side, structure in the centre, and a workspace in the right.
Each object has properties that can be edited – double click on the Eprime object to open it.

Double click properties tab.

Edit the display
- enter words, change background colour, font, position of word etc

Edit the timing & response collection
- duration, response device, response measures (RT, etc)
- Select whether object terminates as soon as response is made.
Variables for stimulus items

[prime] [target]

- Blue names in brackets are variables that can take different values on each trial.
- So on each trial a different prime and target can be displayed.
- The values (words) come from a list in which there are “attribute” columns headed *prime* and *target*.
- Eprime works through the list sequentially (or randomly if you prefer) to present prime \( n \) and target \( n \) on trial \( n \).
- You may be given an Eprime program that needs your trial lists to be entered.
- It’s easy to paste from an Excel workbook into an Eprime list.
Eprime lists

Add and delete rows and columns, properties tab
Lists

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
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<th>Procedure</th>
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</table>

Five trials for the LDT experiment.

Double click on the list object.
ID, Weight, Nested & Procedure columns are already in place.
Use add/delete columns and rows icons to set up table of the right size.
Paste into the cells from an Excel file.
Weight usually = 1 (Each trial presented once).
Procedure cell is needed in the word list only when information from the list is needed for what procedure to use on each trial – e.g., in task switching.

Right vs. left Button (W vs. NW)
How to build a program

- Work out the hierarchical structure of the experiment in terms of event sequences; e.g., memory study:
  - Introduction, study phase; memory test; end
    - Introduction - general & study instructions
    - Study
      - 2 blocks of 20 words each, semantic judgment
    - Test
      - Test instructions
      - 4 blocks of 20 words, old vs. new judgment
    - End – “All done” message
      - Program terminates, data file created.
Example: Memory study

- What procedures?
  1. Session Proc(education)
     Welcome Study-block-list Test-instruct Test-block-list
     Goodbye

  2. Study-block Proc
     Do-2-blocks, 20-trials-per-block Rest

  3. Study-trial Proc
     Ready Present-word Pause (word object collects responses)

  4. Test-block Proc
     Do-4-blocks, 20-trials-per-block Rest

  5. Test-trial Proc
     Ready Present-word Pause (word object collects responses)
Building a program

- Click on *Blank Experiment*; edit the *Experiment* object to set up response devices, display & sound properties.
- Click on the Startup tab to get Eprime to ask for Page, gender, handedness at the beginning of the experiment.

Double click device to edit
Building a program

- Open the total session procedure, `SessionProc`
- Specify in the `SessionProc` the parts of the experiment, in strict order of occurrence
  - Welcome/instructions text display
  - Trial block lists
    - Or study and test phase lists
    - Or sequential task lists, etc.
  - End of experiment text display (Goodbye)
- These parts are objects that sit on the procedure line
Building a program

- Drag across the objects (lists, displays) from the toolbox (left) and drop them on the procedure line in the workspace (right)
- Name the objects and edit them to set their properties
Structure tree

SessionProc:

BlockProc:

NB: The Block procedure BlockProc is listed inside BlockList.

The trial procedure TrialProc is listed inside TrialList.

Add a text display here to make a rest break.
Working down the structure tree

- If you want 2 blocks of trials:
  - Set up a *BlockList* object in your *SessionProc*
  - In the *procedure* column in your *BlockList* object, type in a procedure for running a block
    - Call it *BlockProc*, *StudyBlockProc* or whatever

- Eprime will create a procedure in the Structure Tree as soon as you enter the procedure name in *BlockList*

- Double click to open the new procedure in the workspace, and drag objects onto it.

- Add procedures to lists as required, and work your way down to the end of the session.

- There are conventions for naming things, but you can use almost any name you like.
How do I get multiple blocks & trials?

- The block procedure has just the sequence of events for one block
  - e.g., run a block, take a rest break
- The trial procedure has the events for just one trial
  - e.g., ready signal, mask, prime, target, ITI (pause)
- Create and edit a *List* object to indicate how many times to run a procedure
- Put in BlockProcList how many blocks to run (how many times to run the Block procedure)
- For the memory study we would need different BlockProcLists for study & test (2 blocks vs. 4).
- Note that *lists* are used for stimuli, to indicate iterations of procedures, allocation of stimulus lists to Ps, etc.
ProcLists & Trial Lists

**SessionProc**
- **Welcome**
- **SBlockLI**
- etc.

**SBlockProc**
- **SProcList**
- **Rest**

**StudyLists:**
For counter-balanced list assignment (*Properties, Selection*)

**SBlockList:**
2 study blocks

**SProcList:**
20 trials per block

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Blocks, trials and stimulus lists

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</table>

STTrialProc: Ready, StudyDisplay: [Stword], ITI

Trials 1-20 for block 1, 21-40 for block 2.
Blocks, trials and stimulus lists

- Note that this structure works well if the trial items are in the required order in the stimulus lists
  - If you use random sequencing of trials, you would need separate BlockLists and study lists for each block
    - StudyListA1, StudyListB1 for SBlock1List
    - StudyListA2, StudyListB2 for SBlock2List
  - It’s often easier to randomise lists before pasting them into Eprime.
Assigning Ps to different lists

- For assigning counterbalanced lists, Eprime assigns Ps to lists based on the number you give them
  - With 2 lists, odd numbered Ps get ListA and even-numbered Ps get ListB

- To set this up, go to the list object that contains the list names – i.e. the Studylists object
  - Open Properties and then Selection
  - Choose “Counterbalance” and Order By “Subject”
Durations, responses, data logging

- If Ps make a LDT to the target word, then the LD button press response is logged by the target object (text-display or slide object).
- Edit the *Duration/Input* tab (under *Properties*) to add:
  - the response device (keyboard, mouse, button box etc)
    - Use “port” for button box & microphone
  - allowable response, answer for scoring accuracy.
  - duration and time limit of display,
  - whether display is terminated by a response
    - Enter -1 in duration if you want response-termination and don’t have a time in mind.
- N.B. Devices must also be added to the Experiment object
Click **Advanced** and use **collection** tab to allow multiple responses on the device – e.g., typing a word.
Unique and reusable objects

- If the intertrial interval is always 2 sec, then you can have a text object called ITI and re-use it in different trial procedures.
- Just drag the icon from the original procedure to the new procedure to take a copy.
- You can have the same procedure for say, study and test trials, if the response device, display and timing are the same.
- But note that the responses to each word display object will go into a single column in the data file.
- You may prefer to have a separate study display and test display to create different dependent variables.
Running the program

- Every time you change your program:
  - SAVE then GENERATE

- Generate creates an executable “run script”
- This must be updated when the program is changed
- The program can be run by double clicking on the running figure inside the .es program
  - OR by double clicking on the running-man script file (and typing F7, Eprime 1 only).
- STOP the program = Control_Alt_Shift
Data file

- A P number is given for each participant at the start of the program
- This number is used to name the data file - .edat.
- Open the data file and under Tools/Analysis you can get summary statistics by condition
- e.g., accuracy for Abs vs. Conc
- The accuracy column will be called object.ACC
  - e.g., StudyDisplay.ACC, Target.ACC
- Data files can be merged to produce all summary data in one step for SPSS files
- But for RT data you will probably need to pre-process data outside Eprime
Complications & Limitations

- You can get responses from different devices collected for one object
  - But getting the object to terminate to one and not the other is messy
- You can also get responses that come in after the display has terminated
  - e.g., in perceptual identification
- But having sequences of objects looking for responses in overlapping time windows can cause problems
- If the keyboard response for object A occurs during object B
  - It may terminate object B even if B is looking for a microphone input – but some changes in Eprime 2 may fix this problem
Overview - advantages of Eprime

- Suitable for many different experiments
- Useful for teaching applications – lab classes
- Relatively fast and easy to write a program
  - Easy to adapt an existing program – do this if you can!
  - Easy to get immediate feedback on timing, displays etc
- If you are a programmer you can insert scripts in E-basic (like Visual Basic).
- If used within guidelines, timing is sufficiently accurate for RTs measured in ms
- Has capacity to communicate with other devices
  - e.g., EEG, eye-trackers
- WIDELY used – programs available on the net
Final tips

- You don’t need a deep and comprehensive understanding of Eprime, just enough to do your task
- USE existing programs – colleagues here, collections on the web
  - Check the Eprime page [http://www.pstnet.com/](http://www.pstnet.com/)
- Find a program for a similar task and edit displays, timing and lists.
- BUT ALWAYS run a test of the WHOLE program and check the data file:
- Responses recorded, correct number of trials? Is each P getting the right list, or does each P get bits of all lists?

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