E-prime: A quick & dirty guide

Jenny Burt
With help from Paul Jackson
What is E-prime?

- E-prime 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 E-prime 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.
- E-prime 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 $\frac{1000}{85} = 11.8$ 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: E-prime 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
  - E-prime 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
- E-prime 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 E-prime
Equipment and timing accuracy: Response devices

- The keyboard is OK to use with E-prime 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 E-prime can’t score responses.

- If you also wish to store what was said, you can also record in E-prime (see Paul Jackson).
Eprime vs. other software tools for experiments

- NOTE that E-prime 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 E-prime – but also quite difficult to learn if you have no programming background.
- E-prime probably is the easiest to use, and is available on all PCs in bookable labs
- If you need E-prime for an experiment, see Paul Jackson (School IT staff, here Mon & Thurs)
  - The School has a site licence
E-prime: What can it do?

E-prime 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

&&&&

500 ms
60 ms
time

&&&& GHOST
E-prime 1 vs. 2

- The appearance (icons, colours, layout) may be a bit different depending on whether you have E-prime 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
E-prime 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**
E-prime 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.
Objects for a trial in the LDT experiment

Each object has properties that can be edited – double click on the E-prime 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.
- E-prime 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 E-prime program that needs your trial lists to be entered.
- It’s easy to paste from an Excel workbook into an E-prime list.
E-prime lists

Add and delete rows and columns, properties tab
## Lists

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
<th>prime</th>
<th>target</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>ghost</td>
<td>GHOST</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>fence</td>
<td>TASLE</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>drivel</td>
<td>LEMON</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>trial</td>
<td>VRIAL</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td>party</td>
<td>WITCH</td>
<td>6</td>
</tr>
</tbody>
</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.

3/8/2016
Example: Memory study

What procedures?

1. Session Proc(edere)
   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 E-prime to ask for P age, gender, handedness, at the beginning the experiment.

Double click Devices 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
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 (list) 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

- E-prime 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

SBlockList:
2 study blocks
e.g., memory Expt.

SBlockProc

SProcList

Rest

SProcList:
20 trials per block

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

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td>SBlockProc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>StudyLists</td>
<td>STrialProc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>StudyListA</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>StudyListB</td>
<td></td>
</tr>
</tbody>
</table>
### Blocks, trials and stimulus lists

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
<th>Stword</th>
<th>Ans</th>
<th>Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>echidna</td>
<td>6</td>
<td>Conc</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>drivel</td>
<td>5</td>
<td>Abs</td>
</tr>
<tr>
<td>...40</td>
<td>1</td>
<td></td>
<td></td>
<td>idea</td>
<td>6</td>
<td>Abs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ID</th>
<th>Weight</th>
<th>Nested</th>
<th>Procedure</th>
<th>Stword</th>
<th>Ans</th>
<th>Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>daisy</td>
<td>6</td>
<td>Conc</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>artist</td>
<td>5</td>
<td>Conc</td>
</tr>
<tr>
<td>...40</td>
<td>1</td>
<td></td>
<td></td>
<td>justice</td>
<td>5</td>
<td>Abs</td>
</tr>
</tbody>
</table>

**StudyListA**

**StudyListB**

**STrialProc**

**StudyDisplay**

**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 E-prime.
Assigning Ps to different lists

- For assigning counterbalanced lists, E-prime 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 or infinite 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

- Use Logging tab for data collection (RT, accuracy).
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
- STOP the program = Control_Alt_Shift
- Data will be lost


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 - .edat2.
- 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 E-prime.

3/8/2016
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 E-prime 2 may fix this problem
Overview - advantages of E-prime

- 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
  - Researchers around the world can share programs
Final tips

- You don’t need a deep and comprehensive understanding of E-prime, just enough to do your task

- USE existing programs – colleagues here, collections on the web
  - Check the Eprime page 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?

FOR HELP: Paul Jackson
p.jackson@psy.uq.edu.au