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 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 de 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?

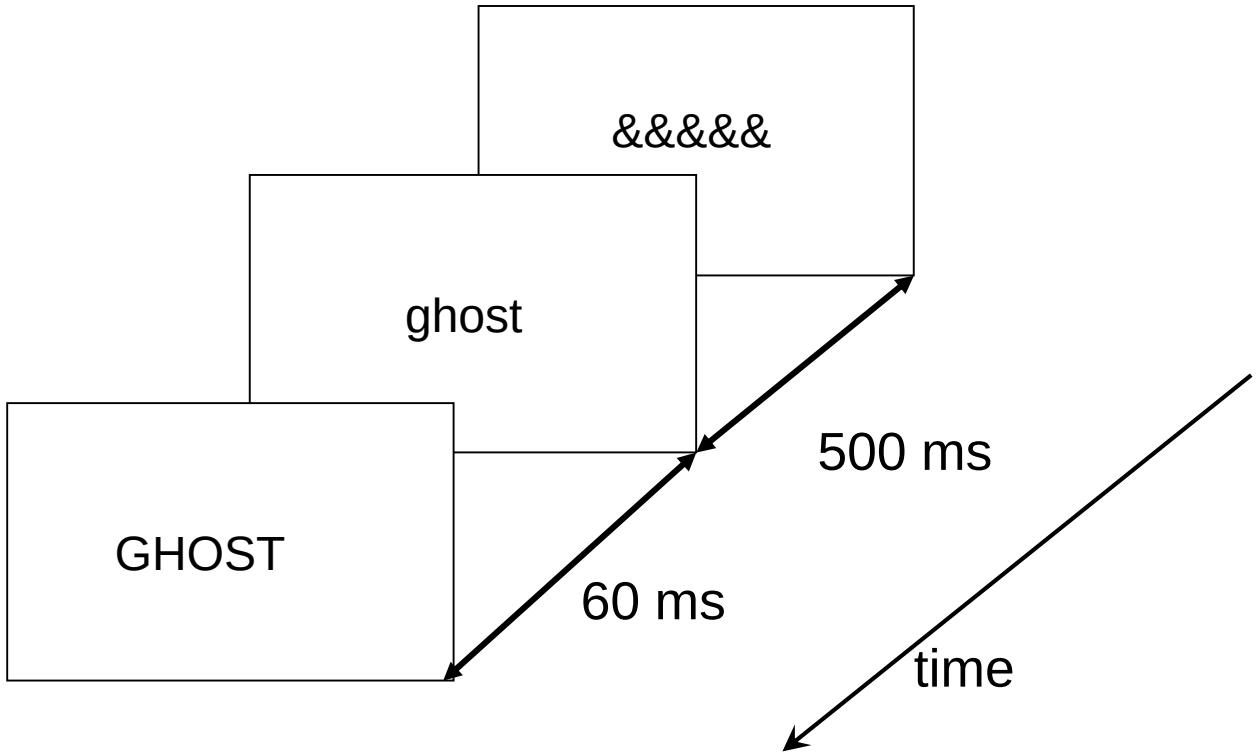
E-prime is ideal if:

- 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:

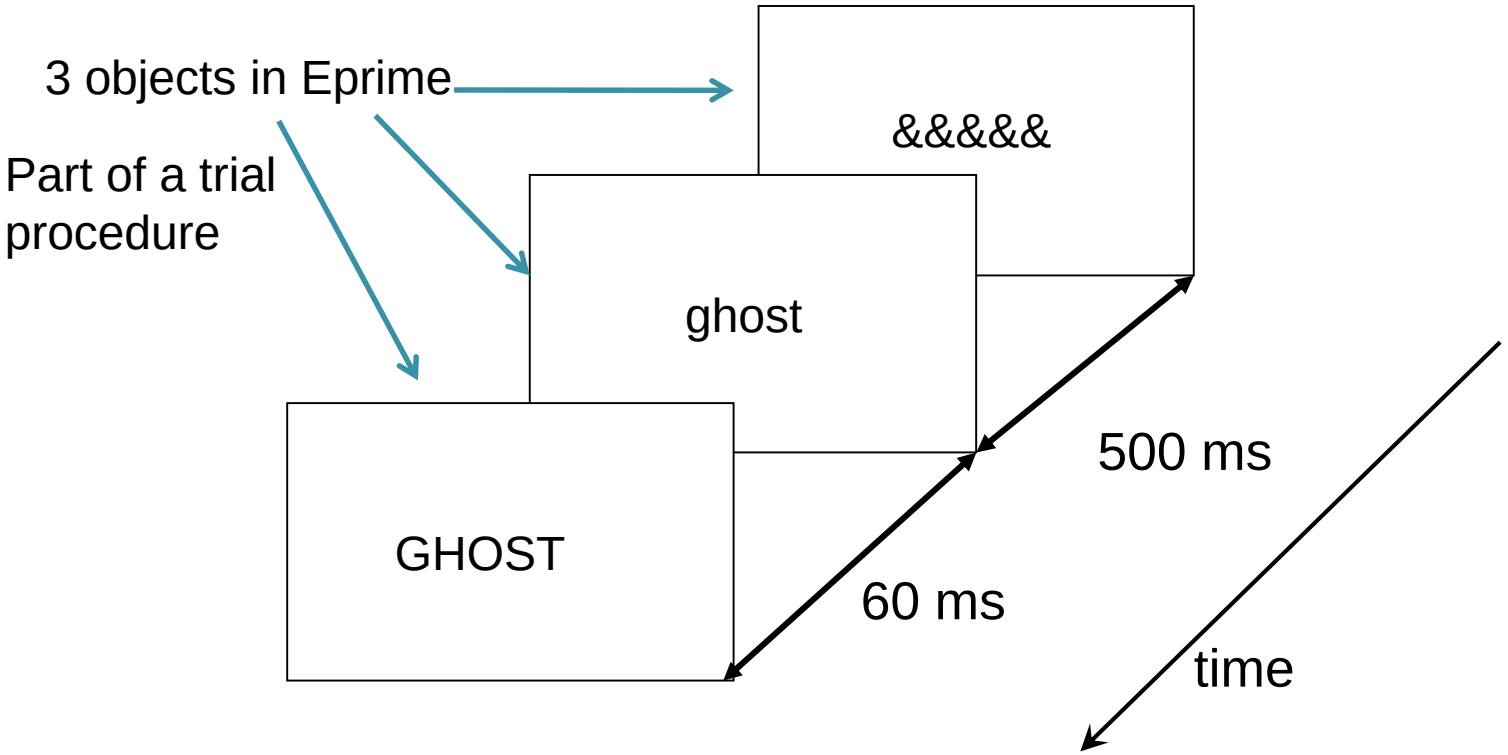
- Lexical decision (LDT), word naming, colour naming, all kinds of decisions such as same/different, left/right, old/new, happy/sad, target identification in RSVP, letter identity in visual search, digit span, operation span, etc

Masked priming in LDT



Participant sees: &&&&& GHOST

Masked priming in LDT



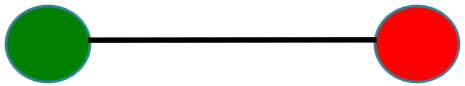
&&&&& GHOST

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



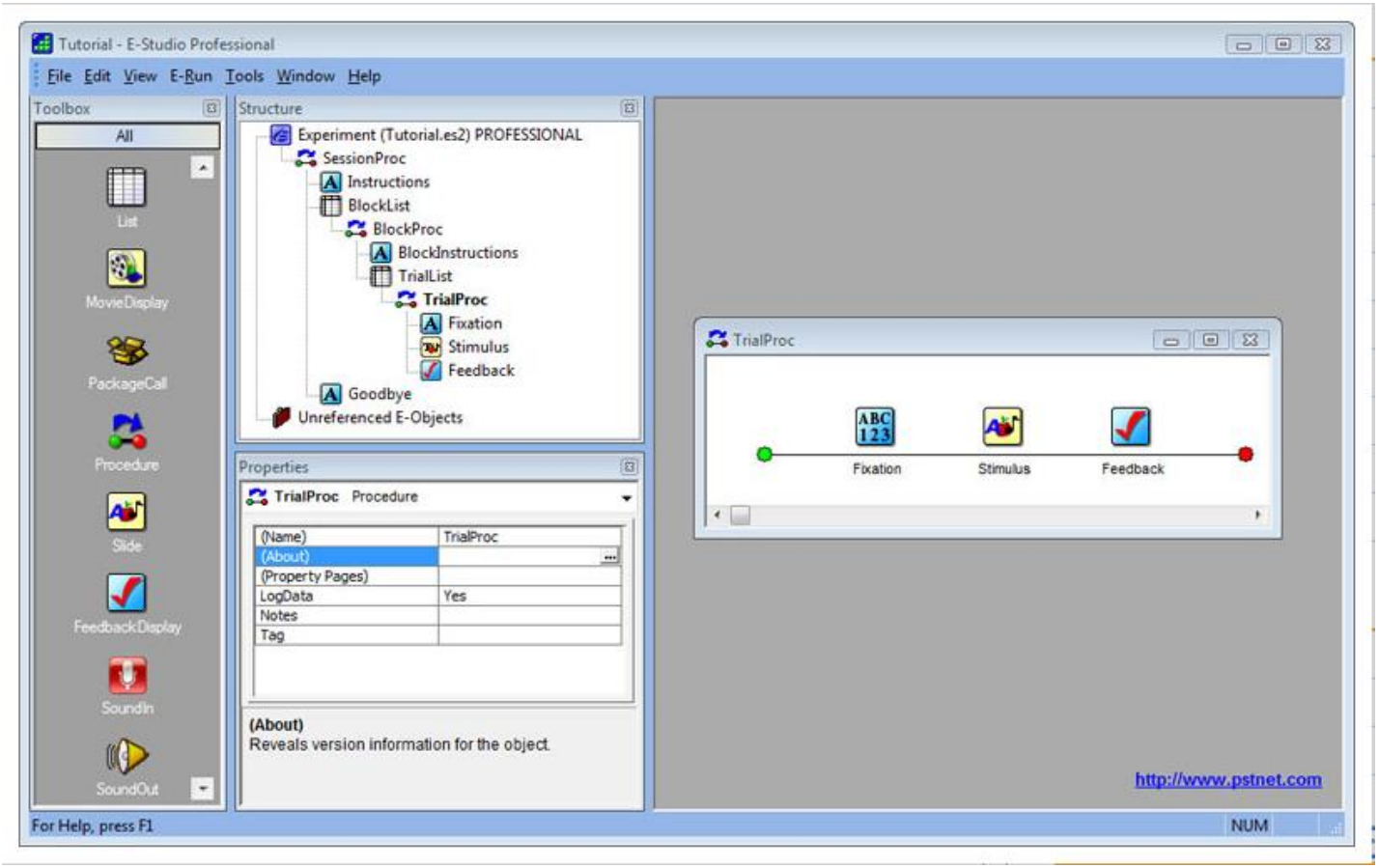
  - The strict sequence of events for parts of the experiment – whole experiment, tasks, phases, blocks, individual trials
- *Feedback* objects
  - Indicate on the screen after each response whether it was correct, fast/slow enough.
- *Timer* objects

E-prime 2: Toolbox and objects

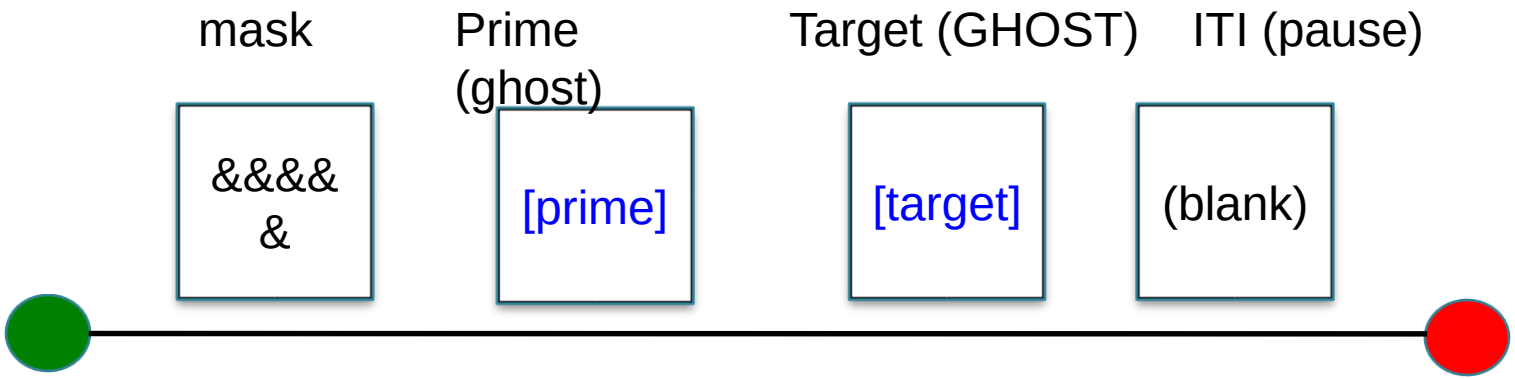
- Text display:
  - Instructions, text and word stimuli, digits, “take a rest break”, etc.
- Slide:
  - Allows presentation of pictures, sound files, bitmap diagrams, etc.
    - Also text
  - Drag SoundOut onto slide to add sound
  - Can edit each part of the slide separately
    - e.g., to have a word 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

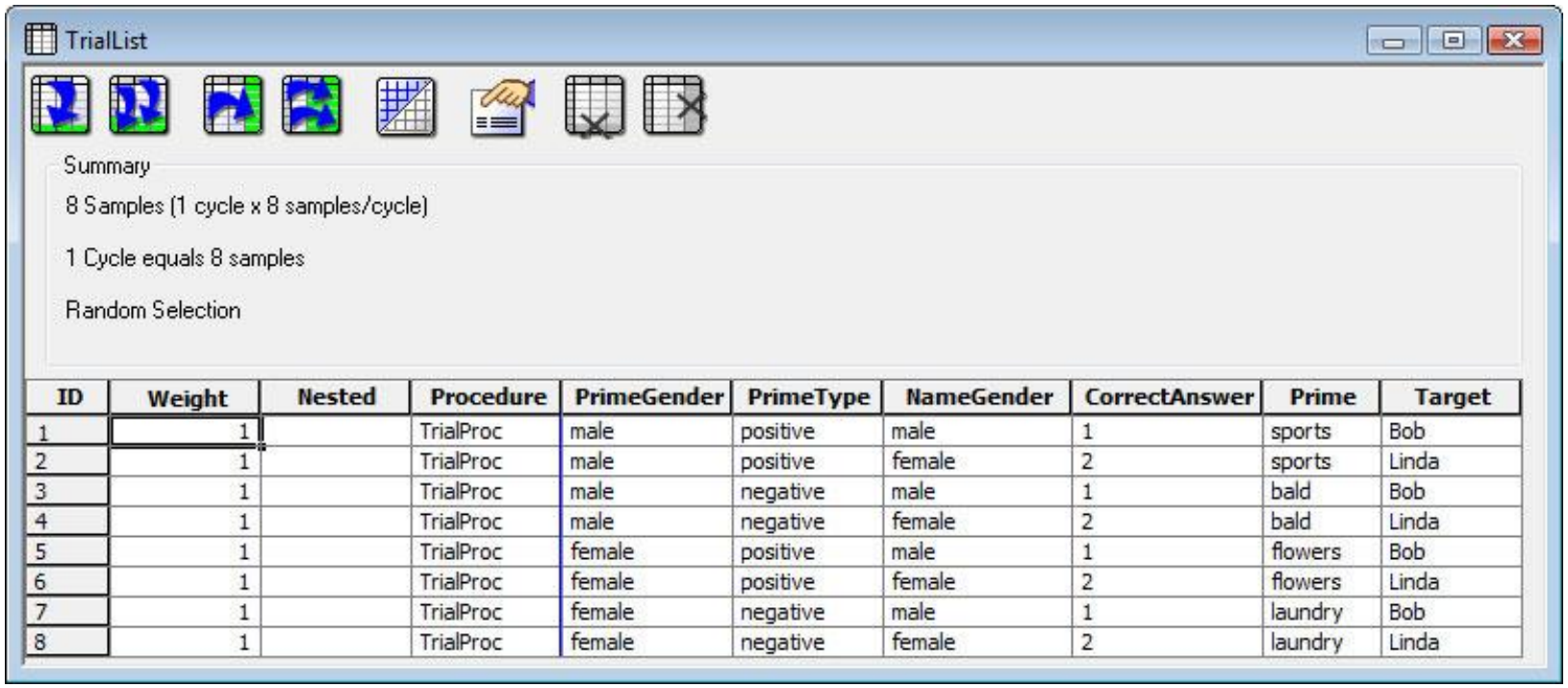
Variables for stimulus items

[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



ID	Weight	Nested	Procedure	PrimeGender	PrimeType	NameGender	CorrectAnswer	Prime	Target
1	1		TrialProc	male	positive	male	1	sports	Bob
2	1		TrialProc	male	positive	female	2	sports	Linda
3	1		TrialProc	male	negative	male	1	bald	Bob
4	1		TrialProc	male	negative	female	2	bald	Linda
5	1		TrialProc	female	positive	male	1	flowers	Bob
6	1		TrialProc	female	positive	female	2	flowers	Linda
7	1		TrialProc	female	negative	male	1	laundry	Bob
8	1		TrialProc	female	negative	female	2	laundry	Linda

Lists

Right vs. left
Button (W vs. NW)

ID	Weight	Nested	Procedure	prime	target	Answer
1	1			ghost	GHOST	6
2	1			fence	TASLE	5
3	1			drivel	LEMON	6
4	1			trial	VRIAL	5
5	1			party	WITCH	6

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

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(edure)

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

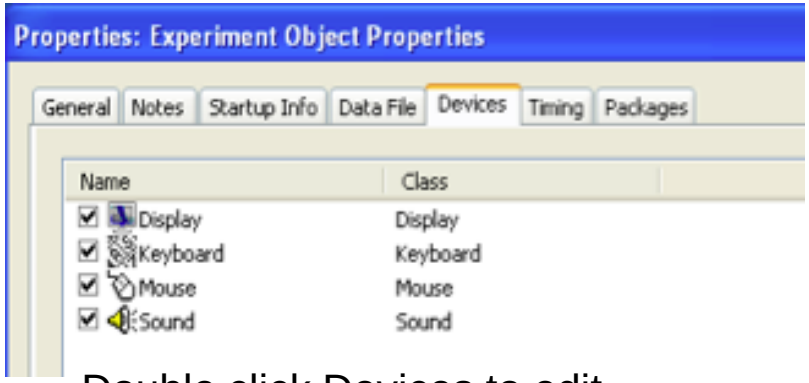
Do-4-blocks, 20-trials-per-block Rest

5. Test-trial Proc

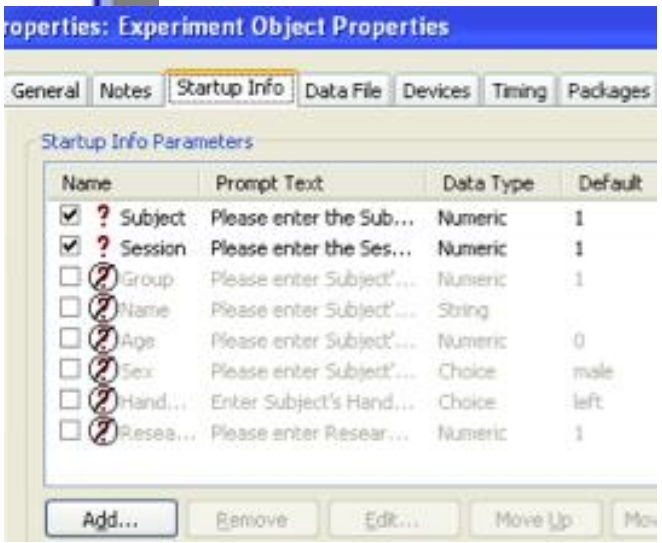
Ready Present-word Pause (word object collects responses)

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

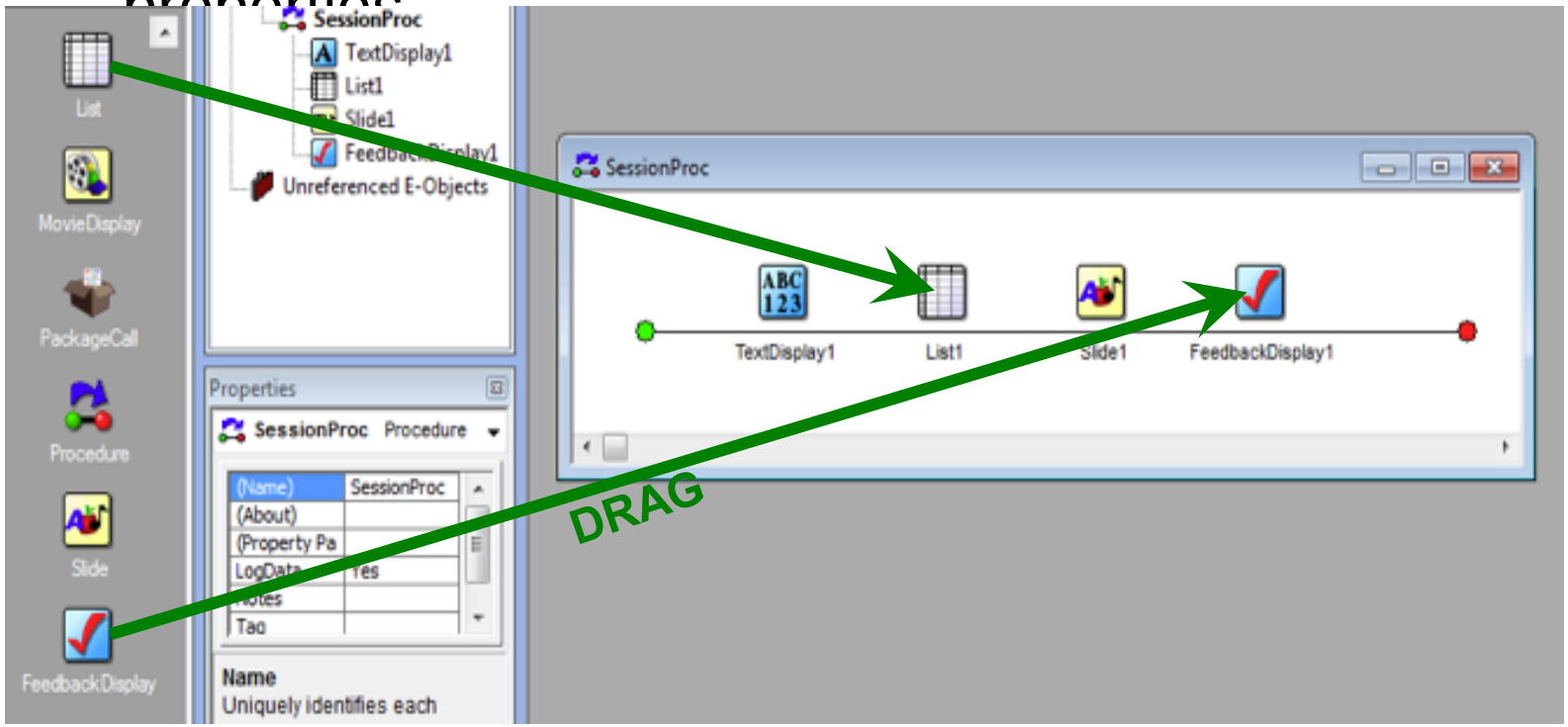


Building a program

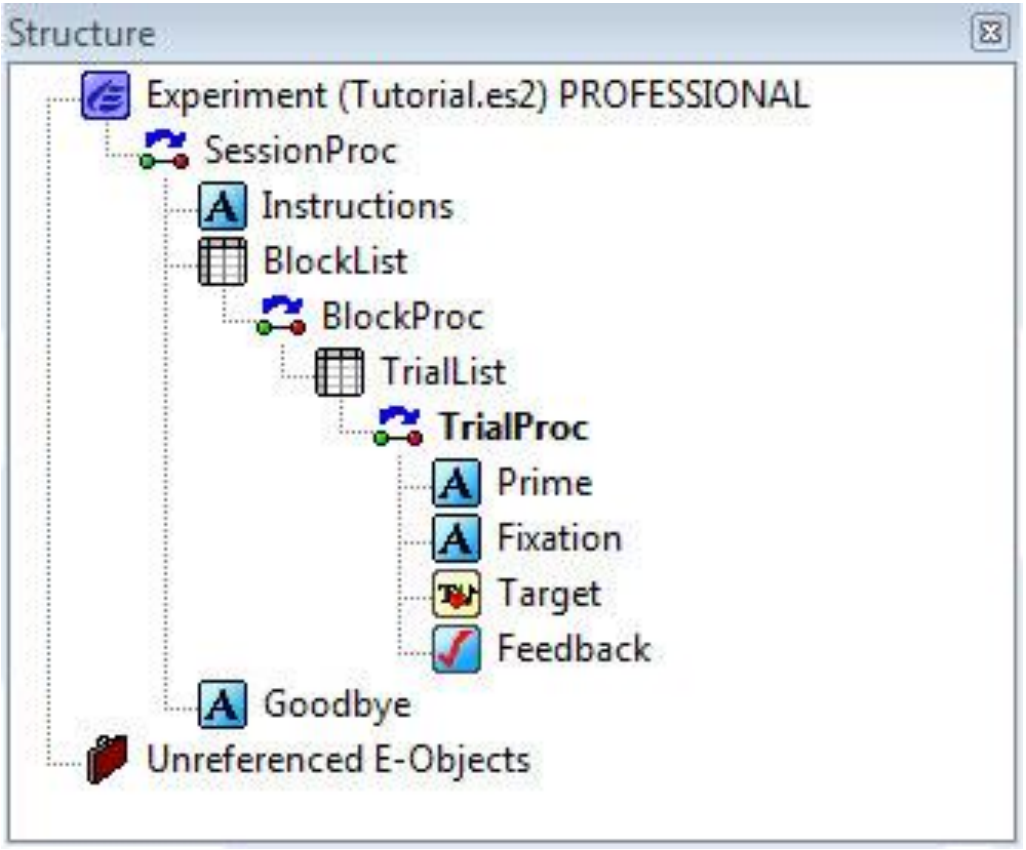
- Open the total session procedure, *SessionProc*
- Specify in the SessionProc the parts of the experiment, in strict order of occurrence
  - Welcome/instructions text display
  - Trial block lists
    - Or study and test phase lists
    - Or sequential task lists, etc.
  - End of experiment text display (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



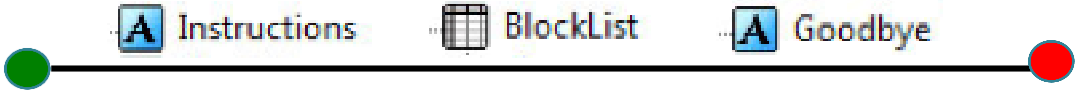
Structure tree



NB: The Block procedure BlockProc is listed inside BlockList.

The trial procedure TrialProc is listed inside TrialList.

SessionProc:



BlockProc:

Add a text display here to make a rest break

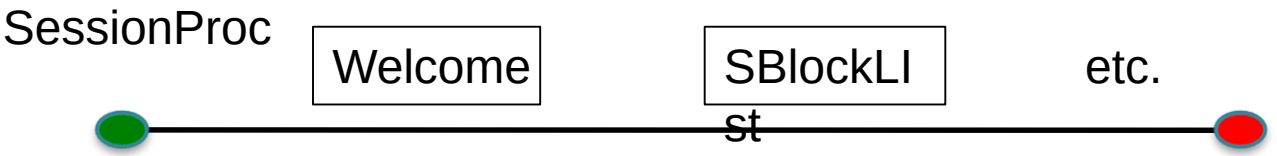
Working down the structure tree

- 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.

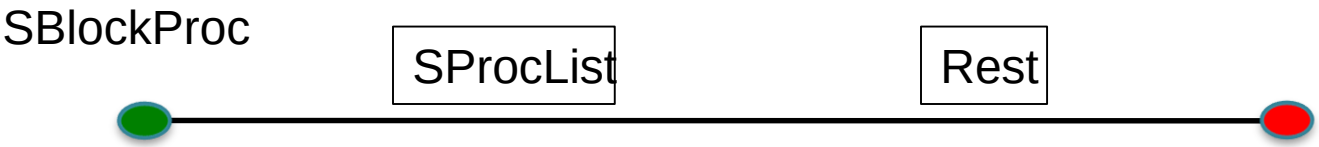
ProcLists & Trial Lists



e.g., memory Expt.

ID	Weight	Nested	Procedure
1	2		SBlockProc

SBlockList:
2 study blocks



ID	Weight	Nested	Procedure
1	20	StudyLists	STrialProc

SProcList:
20 trials per block

ID	Weight	Nested	Procedure
1	1	StudyListA	
2	1	StudyListB	

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

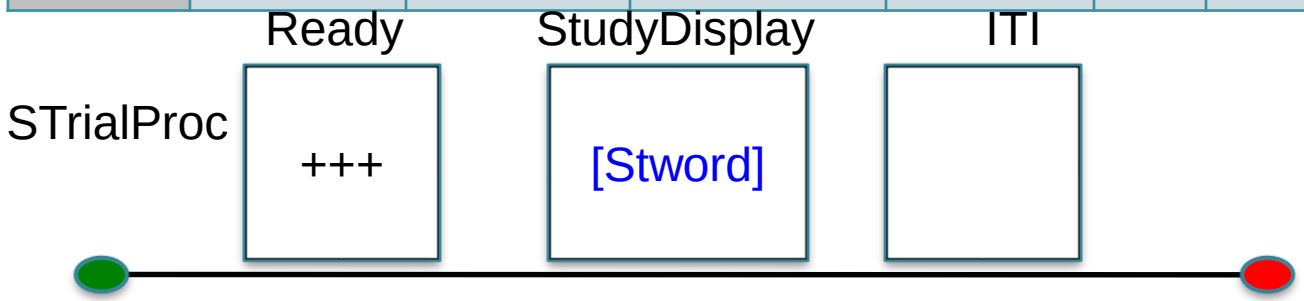
Blocks, trials and stimulus lists

ID	Weight	Nested	Procedure	Stword	Ans	Cond
1	1			echidna	6	Conc
2	1			drivel	5	Abs
…40	1			idea	6	Abs

StudyListA

ID	Weight	Nested	Procedure	Stword	Ans	Cond
1	1			daisy	6	Conc
2	1			artist	5	Conc
…40	1			justice	5	Abs

StudyListB



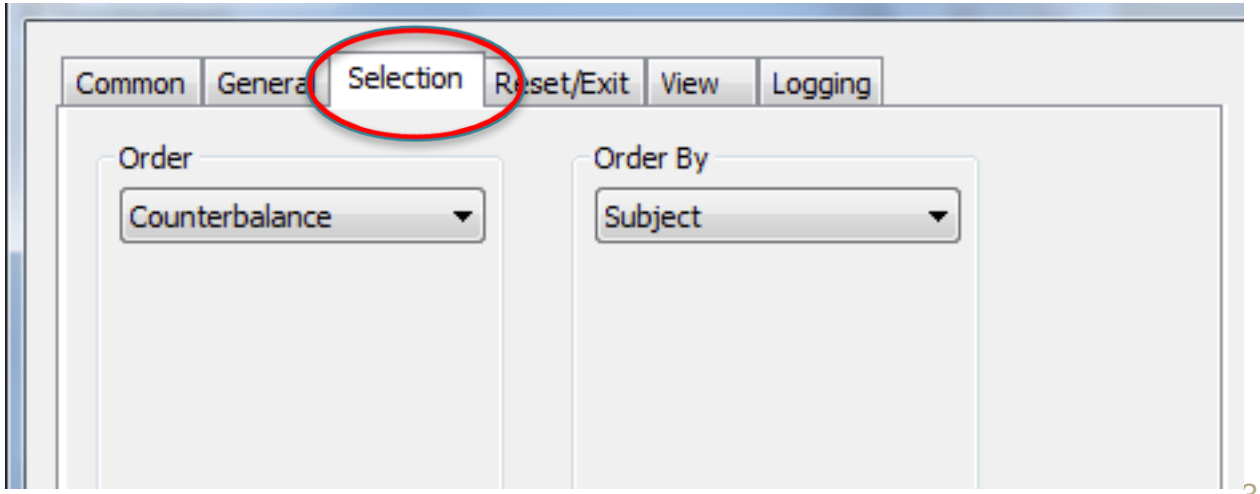
Trials 1-20 for block 1, 21-40 for block 2.

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

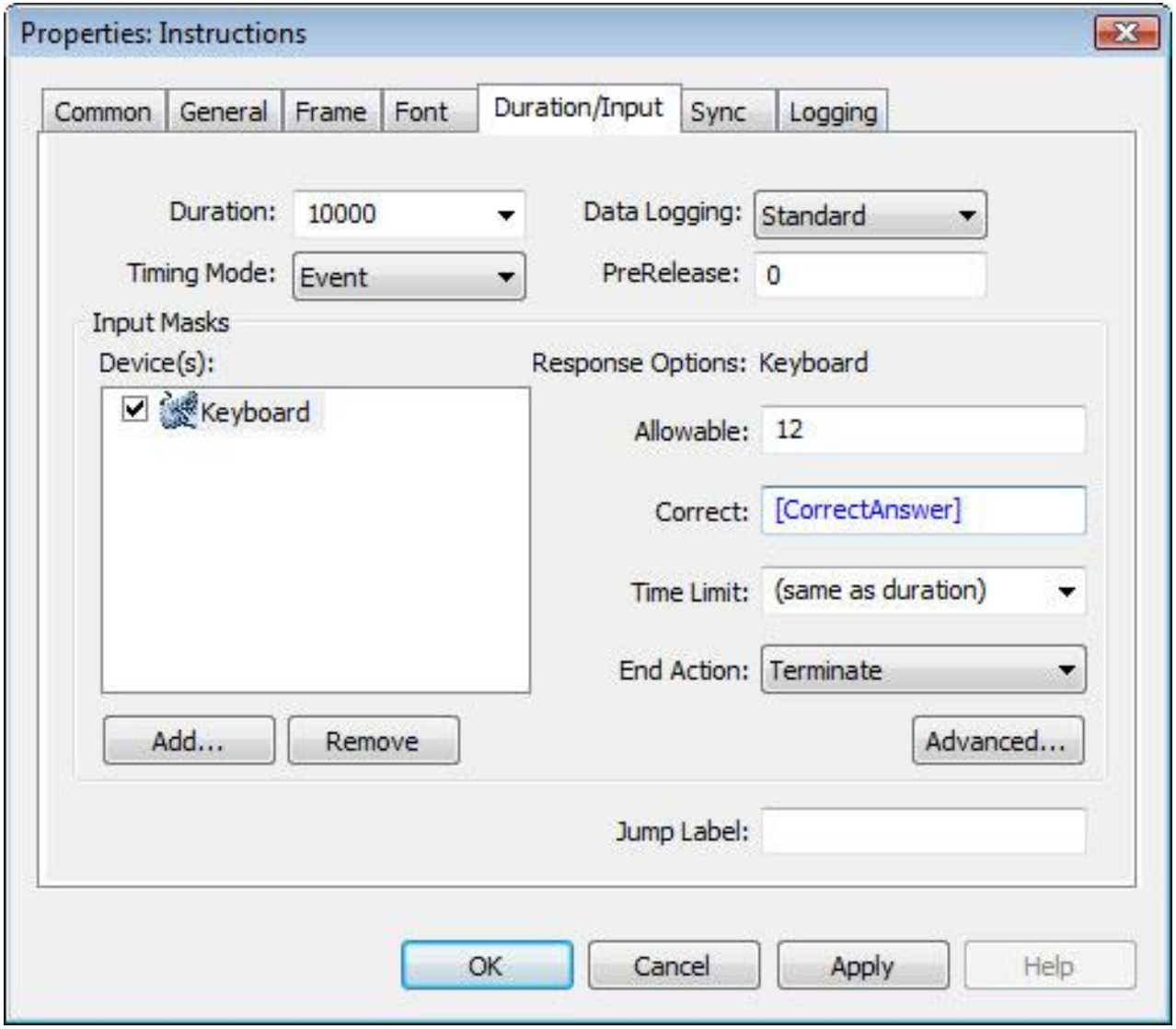
- For assigning counterbalanced lists, E-prime assigns Ps to lists based on the number you give them
  - With 2 lists, odd numbered Ps get ListA and even-numbered Ps get ListB
- To set this up, go to the list object that contains the list names – i.e. the Studylists object
  - Open Properties and then 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).

Duration/Input



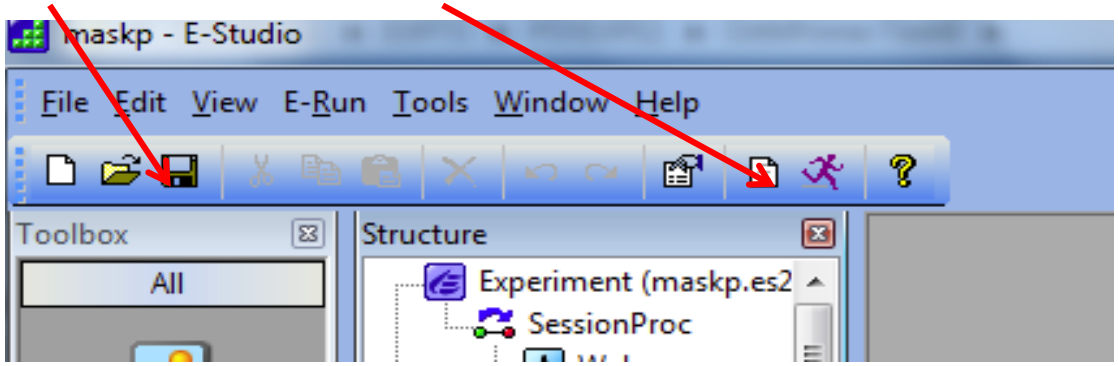
Click Advanced and use collection tab to allow multiple responses on the device – e.g., typing a word

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

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