Ten years of Open Source Psychology The Psychology Experiment Building Language and Test Battery

Shane T. Mueller Dept of Cognitive and Learning Sciences Michigan Technological University

Brian J. Piper Husson University

http://pebl.sourceforge.net/



What is PEBL?

- An open source cross-platform programming language for psychology.
- A battery of (≈70) tests from experimental and clinical neuropsychology.
- <u>http://pebl.sourceforge.net/</u>
- An ad hoc collaborative research effort
- A Tech report series
- A blog http://peblblog.blogspot.com





PEBL the programming language

- Goal is to be simple to write simple experiments, simple to modify existing experiments.
- Motivation: locking away science tools hurts collaboration, reuse, replication, and is ultimately anti-scientific.

😣 🖨 PEBL Experiment							
PEBL Launcher for PEBL Version 0.13							
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A PEBL Experiment

define Start(p)

curtime <- GetTime()

```
pskip <- .4 #proportion of trials that jump
gRad <- 240 #radius, in pixels, of clock circle
 gSize <- 9 #size of target
 trials <- 60 #Number of 1-second trials
 gWin <- MakeWindow("black")
 gBasecolor <- MakeColor("white")
 gTargcol <- MakeColor("red")
gHomeX <- gVideoWidth/2
gHomeY <- gVideoHeight/2
#Get starting position and put red target there.
xy \leq GetXY(1)
 targ <- Circle(First(xy),Second(xy),gSize,gTargcol,1)</pre>
 AddObject(targ,gWin)
 ##Create target positions:
 pos <- [] ; circs <- []
mins \leq-Sequence(1,60,1)
 loop(i,mins)
  xy <- GetXY(i)
  pos <- Append(pos,xy)</pre>
  circ <- Circle(First(xy), Second(xy),gSize,gBaseColor,0)
  AddObject(circ,gWin)
   circs <- Append(circs,circ)
 ShowCursor(0)
 tb <- EasyTextBox ("Press any key to begin."+CR(2)+
"Hit space bar when red circle skips a position.",250,200,gWin,22,300,120)
 Draw()
WaitForAnyKeyPress()
 tb.text <- "Watch the red target. "+CR(2)+"Hit space bar when red circle skips a position."
MakeDirectory("data")
 fileOut <- FileOpenWrite("data/clock-"+gSubNum+".csv")
FilePrint(fileout, "subnum, trial, ticker, sec, skip, resp, corr, starttime, rt, curtime")
trial <- 1
ticker <- 1
second <- 1
doskip <- 0
lastend <- GetTime()
 while(trial <= trials)h
 ##compute seconds/clock position, and move there.
 second <- Mod(ticker,60)
  pos <- GetXY(second)
  Move(targ,First(pos),Second(pos))
  Show(targ)
  Draw()
  ##cycle should end 1000 ms after current
 nexttime <- lastend + 1000
```

```
resp <- WaitForListKeyPressWithTimeout([" "],nexttime - curtime,1)
  rtime <- GetTime()
  ##Score response
  if(not lsList(resp))
    pressed <- 1
    Wait(nexttime - GetTime())
  } else {
    pressed <- 0
   if(resp == " ")
    resp <- 1
   }else{
    resp <- 0
  corr <- resp == doskip
  FilePrint(fileout,gSubNum + "," + trial + "," + ticker + "," + second + "," + doskip+
              "," + resp +"," + corr + "," + rtime + "," + (rtime - curtime) + "," + GetTime())
  lastend <- GetTime()</pre>
  ##Determine if we should skip on this trial.
  if(Random() < pskip)
    doskip <- 1
  } else {
    doskip <- 0
  trial <- trial + 1
  ticker <- ticker + doskip + 1
  ##Do a brief disappear of the target.
  Hide(targ)
  Draw()
  Wait(400)
 tb.text <- "Thank you. Hit 'x' to exit"
 Draw()
 WaitForKeyPress("X")
##Gets x,y coordinates based on 1:60 minutes.
define GetXY(minute)
  angle <- 2*3.14159/360 * (minute * 6 -90)
  x <- gRad * Cos(angle) + gHomeX
  y <- gRad * Sin(angle) + gHomeY
 return [x,y]
```

Mackworth "Clock Test"



Development History and Current Status

- Implementation began 2002
- First released 2003
- First Test Battery 2006

2012:

- 108,000 cumulative downloads
- 65-70 tests available
- 100+ member email list
- Used/cited by ~80 published manuscripts.
- Web traffic:
 - sourceforge: 100K pageviews/year
 - PEBL Blog: 40,000 pageviews
 - Youtube: 23,000 views
- Version 0.13 about to be released.

Total PEBL Downloads = 108,524



Origin of Downloaders: 27% US Operating System: Windows 85% 150 Countries (go Mauritius!)

EBL Test Batter



Corsi Blocks





TOVA

"Iowa" gambling task

Select deck by pressing key 1-4

3

4

Total: \$3200

Pursuit Rotor



NASA TLX

1

Choice: Reward:

Penalty:

Net Gain: \$100

2

\$100 \$-0

Complete. Click CONE or continue to adjust					
Sector 1	Sector 1	10000	Induction	-	(Construction)
	Sector in	1000			
			100	101	
			-		



Tower of London



Wisconsin Card Sort



respond using shift keys DEVENENT

Matrix Rotation



Connections task



http://pebl.sf.net



FIG. 3. A PURSUITMETER (OR PURSUIT ROTOR) The jointed stylus is lying on the turntable.

Lafayette Instrument.

Motor Skills

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Standalone Psych Assessment

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Advanced Search

Search

Trail Making Test

- Part A: <u>1-2-3-4-5</u>
- Part B: 1-A-2-B-3
- Halstead-Reitan Battery Test Battery: 1955
- \$50/age (9-14, 15+)
- Our version uses one-ofa-kind layout logic to enable multiple forms





Click on highlighted circle to start

Sometimes, the test will require you to use an alternating pattern of letters and numbers, either A-1-B-2 etc., or 1-A-2-B etc. The type of test will be labeled at the bottom of the screen. Try a second trial with the alternating letters.

9.7

Wisconsin Card Sorting Test

- Developed by Berg & Grant in 1940s/50s
- Measures cognitive flexibility and perseverative behaviors (number, color, shape)
- Norms for all versions are from paper test.

Psychological Assessment Resources Wisconsin Card Sort Test (\$675) Psychology Experiment Building Language Berg Card Sort Test





Continuous Performance Test

- Sustained attention & vigilance
- Many variations including Conners' CPT

Pearson Assessments (\$749)

CPT II Practice Administration	×		
Welcome to the CPT II Practice Administration.			
Press the Spacebar or click the LEFT mouse button for all letters EXCEPT for the X.			
Please respond as quickly as possible but also as accurately as possible.			
When you click the OK button below, the Practice Administration begins.			
OK			





You are about to take part in an experiment that involves paying attention to letters on a screen.

It will take about 14 minutes.

You will see letters presented on a screen quickly.

Your goal is to press the spacebar as fast as possible after each letter, except if the letter is an 'X'.

DO NOT RESPOND to X stimuli.

To begin, press the <spacebar>.





Selected Publications Using PEBL (80+)

- Aggarwal, R., Mishra, A., Crochet, P., Sirimanna, P., & Darzi, A. (2011). Effect of caffeine and taurine on simulated laparoscopy performed following sleep deprivation. <u>British Journal of Surgery, 98</u>, 1666-1672.
- Clark, D. G., & Kar, J. (2011). Bias of quantifier scope interpretation is attenuated in normal aging and semantic dementia. Journal of <u>Neurolinguistics, 24</u>, 411-419.
- Danckert, J., Stöttinger, E., Quehl, N., & Anderson, B. (2011). Right hemisphere brain damage impairs strategy updating. <u>Cerebral</u> <u>Cortex.</u>
- de Visser, L., van der Knaap, L., van de Loo, A., van der Weerd, C., Ohl, F., & van den Bos, R. (2010). Trait anxiety affects decision- making differently in healthy men and women: Towards gender-specific endophenotypes of anxiety. <u>Neuropsychologia, 48</u>, 1598-1606.
- Gullo, M. J., & Stieger, A. A. (2011). Anticipatory stress restores decision-making deficits in heavy drinkers by increasing sensitivity to losses. Drug and Alcohol Dependence, 117, 204-210.
- Lipnicki, D. M., Gunga, H. C., Belavy, D. L., & Felsenberg, D. (2009). Bed rest and cognition: Effects on executive functioning and reaction time. <u>Aviation, Space, & Environmental Medicine, 80(12)</u>, 1018-1024.
- Lipnicki, D. M., Gunga, H., Belavy, D. L., & Felsenberg, D. (2009). Decision making after 50 days of simulated weightlessness. Brain Research, 1280, 84-89.
- Lyvers, M., & Tobias-Webb, J. (2010). Effects of acute alcohol consumption on executive cognitive functioning in naturalistic settings. <u>Addictive Behaviors, 35 (11)</u>, 1021-1028.
- Mueller, S. T. (2010). A partial implementation of the BICA cognitive decathlon using the Psychology Experiment Building Language (PEBL). International Journal of Machine Consciousness, 2, 273-288.
- Mueller, S. T., & Weidemann, C. T. (2008). Decision noise: An explanation for observed violations of signal detection theory. <u>Psychonomic Bulletin & Review, 15(3),</u> 465-494.
- Ness, V., Arning, L., Niesert, H. E., Stuettgen, M. C., Epplen, J. T., & Beste, C. (2011). Variations in the GRIN2B gene are associated with risky decision-making. <u>Neuropharmacology</u>, 61(5-6), 950-956.
- Piquet, M., Balestra, C., Sava, S., & Schoenen, J. (2011). Supraorbital transcutaneous neurostimulation has sedative effects in healthy subjects. <u>BMC Neurology, 11(1)</u>, 135.

http://sourceforge.net/apps/mediawiki/pebl/index.php?title=Publications citing PEBL

Interesting Publications

Two psychologists walk into a bar

Lyvers, M., & Tobias-Webb, J. (2010). Effects of acute alcohol consumption on executive cognitive functioning in naturalistic settings. Addictive Behaviors, 35 (11), 1021-1028. doi:10.1016/j.addbeh.2010.06.022

Offshore sailing

 Hurdiel R., McCauley P., Peze T., & Theunynck (2011). Sleep deprivation, performance and mathematical prediction of fatigue in offshore sailing races. The 14th International Congress of ACAPS (Association des Chercheurs en Activités Physiques et Sportives), October, 2011.

A year in Antarctica

Premkumar, M., Sable, T., Dhanwal, D., & Dewan, R. (2012). Circadian levels of serum melatonin and cortisol in relation to changes in mood, sleep and neurocognitive performance, spanning a year of residence in Antarctica. Neuroscience Journal

Mission to Mars?

Lipnicki, D. M., Gunga, H., Belavy, D. L., & Felsenberg, D. (2009). Decision making after 50 days of simulated weightlessness. Brain Research, 1280, 84-89. doi:10.1016/j.brainres.2009.05.022

Robots Attack

 Cakmak, M., Srinivasa, S. S., Lee, M. K., Kiesler, S., & Forlizzi, J. (2011). Using Spatial and Temporal Contrast for Fluent Robot-Human Hand-overs. 6th ACM/IEEE International Conference on Human-Robot Interaction, February, 2011

Some Reflections

Intellectual Property

Publishing vs. Publicity

Citations and References

The Future

Intellectual Property

- DMCA Takedown and legal threat by SpecialtyAutomated
- PAR's assertion of copyright over such tests (including Stroop!)
- Use of marks such as WCST, IGT, etc.
- Reuse of PEBL imagery in papers, online, and in other tests

Publishing and Publicity

- Publicity, users reached, and technical support gained via blogging is much greater than traditional publishing.
- Methodologist's Dilemma:
 - Many users reluctant to use tests when a normed data set does not exist.
 - Norm data sets are hard to publish, and frequently get rejected without review.



Citations and References

- Substantial number of PEBL users do not cite me or even sometimes reference PEBL.
- APA guidelines do not help (recommend a footnote/no citation for software).
- Note to editors and reviewers: this matters. (Citations are merit badges)

The Future

SDL 2.0 is on the horizon, and will provide:

- better use of 3D video hardware
- Cleaner audio input/output
- Better internationalization
- More Hardware devices
 - Easier ways to select device of script
- Tablet version(s)
 - Feasible and likely
- Development Environment?
 - Possible if someone takes this on.
- On-line version?
 - Feasible but unlikely

Some Uses afforded by Open Source

- Teaching: PEBL installed on every computer on campus
- Domain experts download special distribution; PEBL phones home data. (Python was a nightmare here).
- Application: set up in gov't labs without installation, IP restrictions, etc.
- Translations are solved by users and contributed back to the main distribution.

Tower of London

- Developed by Shallice (1982) to study planning
- Simplified version of the Tower of Hanoi
- Sensitive to brain damage
- 10-12 variations supported in PEBL





Ethics: The Wikipedia Wars

- There is currently a proxy war going on via wikipedia about ethics and test transparency.
- Clinicians (supported by guilds such as APA) have ethical guidelines about test disclosure.
- Stimuli and descriptions of test materials on wikipedia repeatedly get deleted (IGT, Rorschach, Wisconsin Card Sort)

Experimentation Software/Libraries

- Many to choose from
- Each have their own niches
- PEBL's niche is as a free platform with many built-in tests that can be easily modified to suit needs of testing.
- Its "competitors" are more the clinical testing shops.

Name 🔶	Operating System 🔶	License type 🔹
DMDX [1]@	Microsoft Windows	Free Software
E-Prime [2] 🖗	Microsoft Windows	Proprietary Software
Experimental Run-Time System [3] 🖉	Microsoft Windows	Proprietary Software
Expo [4] 🖨	Mac	Unknown
Expyriment [5] 🖗	Linux Microsoft Windows Mac	Free Software
Inquisit [6] 🗗	Microsoft Windows	Proprietary Software
OpenSesame [7]	Microsoft Windows Linux	Free Software
Paradigm [8] 🖗	Microsoft Windows	Proprietary Software
PEBL [9] 🖗	Linux Mac Microsoft Windows	Free Software
Presentation [10]	Microsoft Windows	Proprietary Software
PsychoPy [11] 🖗	Linux Mac Microsoft Windows	Free Software
Psykinematix [12]	Mac	Proprietary Software
PsyScope [13]	Mac	Free Software
PsyToolkit [14] @	Linux	Free Software
Psychtoolbox for MATLAB [15] 🖗	Linux Mac Microsoft Windows	Free Software
PyEPL [16] 🗗	Linux Mac	Free Software
SPIC Software [17]	Microsoft Windows	Free Software
Superlab [18] 🖗	Mac Microsoft Windows	Proprietary Software
Tscope [19]	Linux Mac Microsoft Windows	Free Software
Vision egg [20] 🗗	Linux Mac Microsoft Windows	Free Software
Webexp2 [21]	Web-based	Free Software