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

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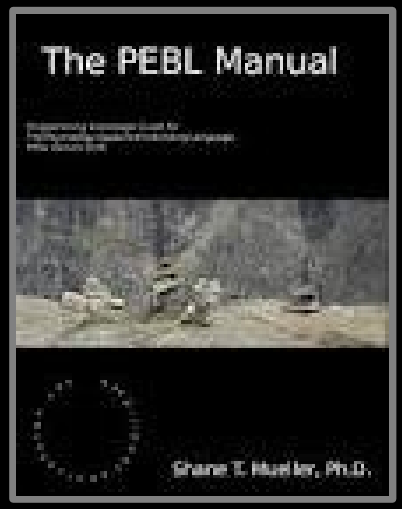
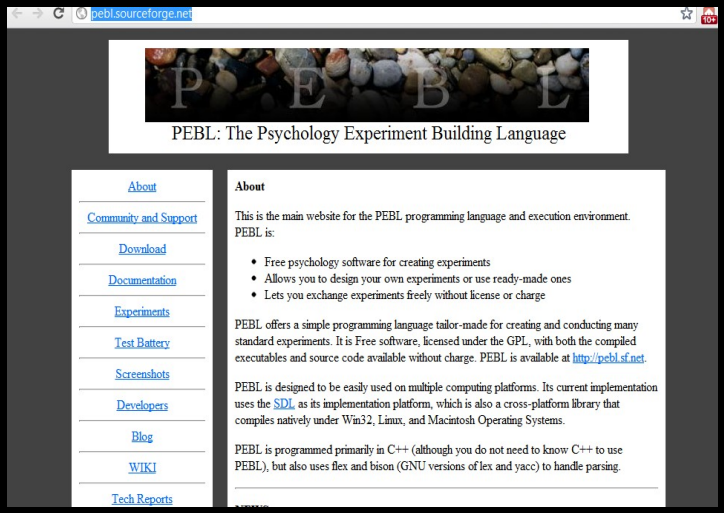
http://pebl.sourceforge.net/

# What is PEBL?

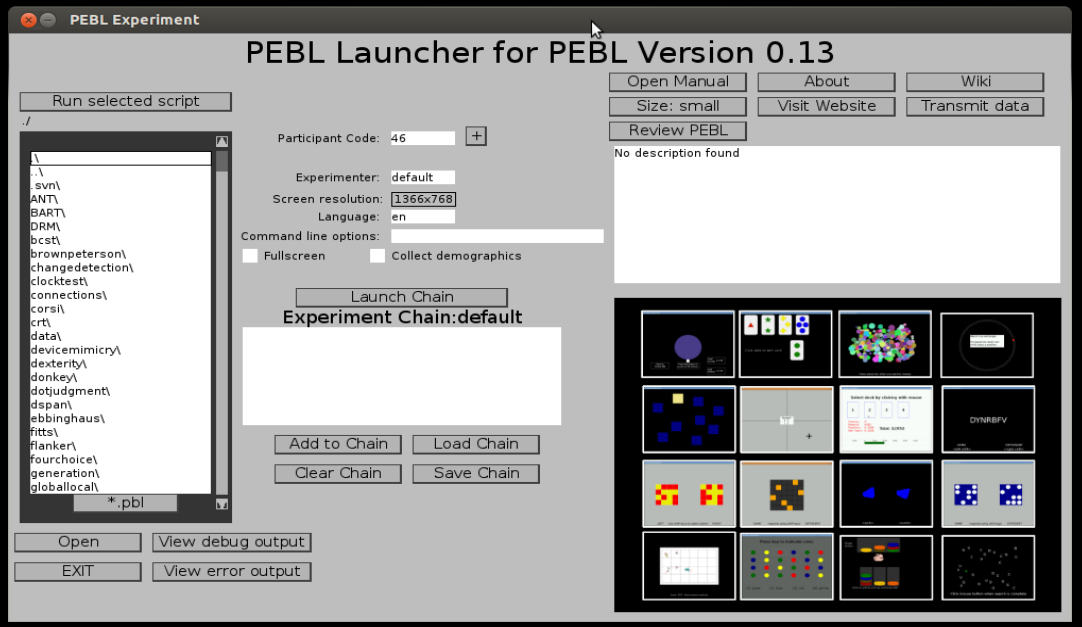
- An open source cross-platform programming language for psychology.
- A battery of (≈70) tests from experimental and clinical neuropsychology.
- http://pebl.sourceforge.net/
- An ad hoc collaborative research effort
- A Tech report series
- A blog http://peblblog.blogspot.com



# PEBL the programming language

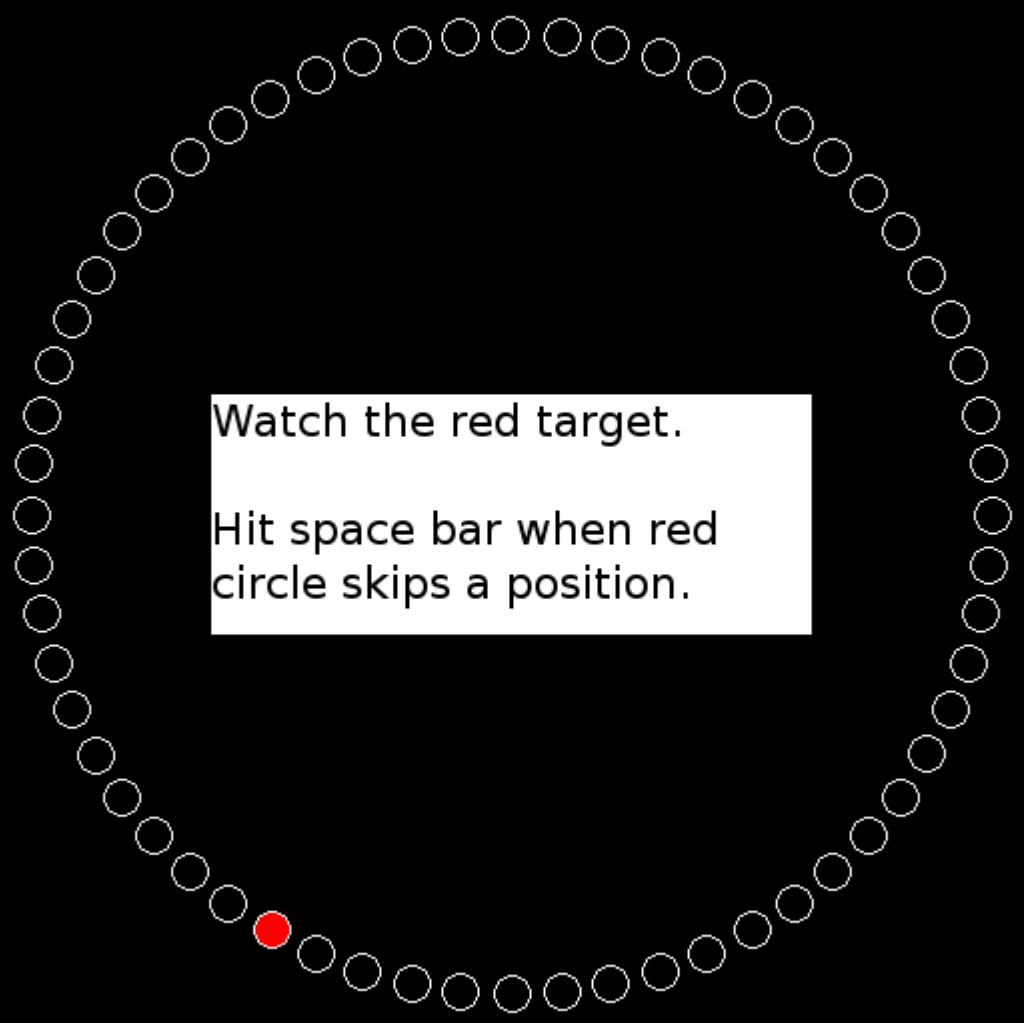
- Goal is to be simple to write simple experiments, simple to modify existing experiments.
- Motivation: locking away science tools hurts collaboration, reuse, replication, and is ultimately anti-scientific.



# A PEBL Experiment

```
define Start(p)
{
  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 <- GetXY(1)
  targ <- Circle(First(xy),Second(xy),gSize,gTargcol,1)
  AddObject(targ,gWin)

  ##Create target positions:
  pos <- [] ;  circs <- []
  mins <- Sequence(1,60,1)
  loop(i,mins)
  {
     xy <- GetXY(i)
     pos <- Append(pos,xy)
     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
    curtime <- GetTime()
    resp <-  WaitForListKeyPressWithTimeout([" "],nexttime - curtime,1)
    rtime <- GetTime()
    ##Score response
    if(not IsList(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()
    ##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

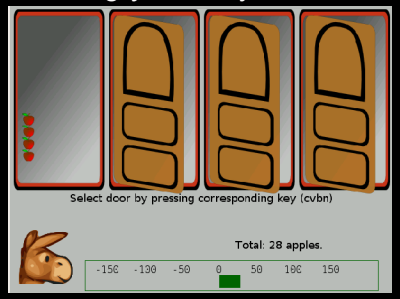
- Version 0.13 about to be released.

# Total PEBL Downloads = 108,524

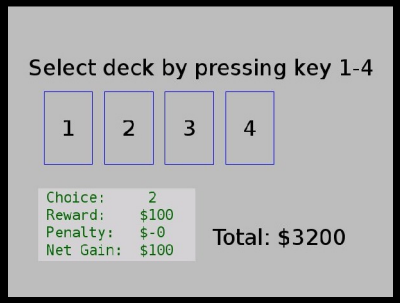

Origin of Downloaders: 27% US
Operating System: Windows 85%
150 Countries (go Mauritius!)

# PEBL Test Battery

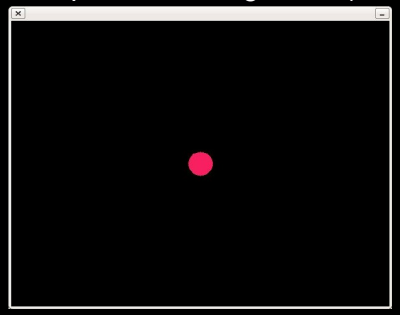
Hungry Donkey Task



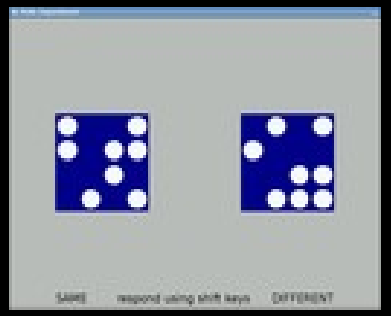

"Iowa" gambling task



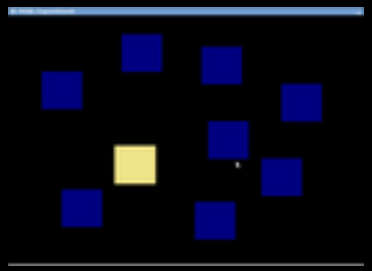

Perceptuo-motor vigilance (PVT)



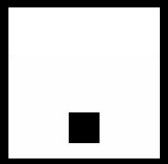
Pattern Comparison



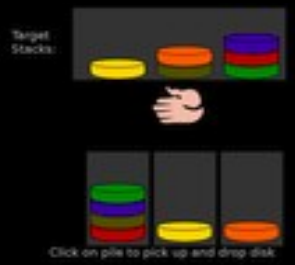
Corsi Blocks



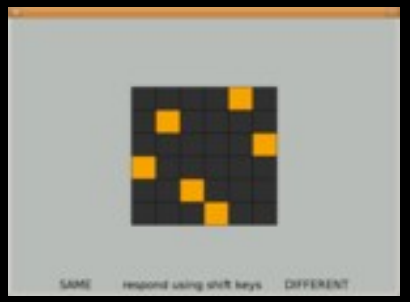
TOVA



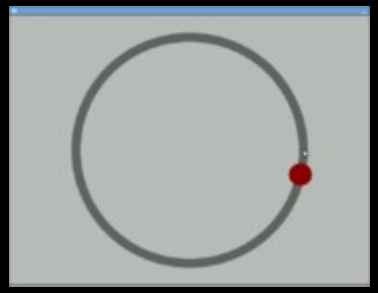
Tower of London




Matrix Rotation

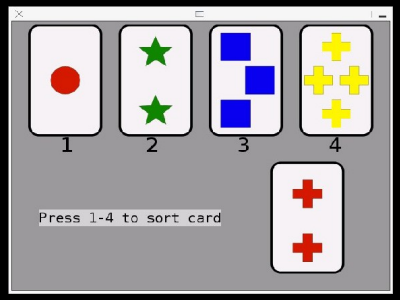



Pursuit Rotor

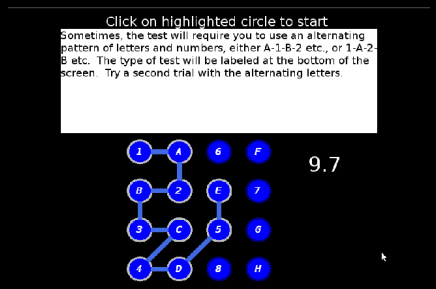


NASA TLX

Wisconsin Card Sort



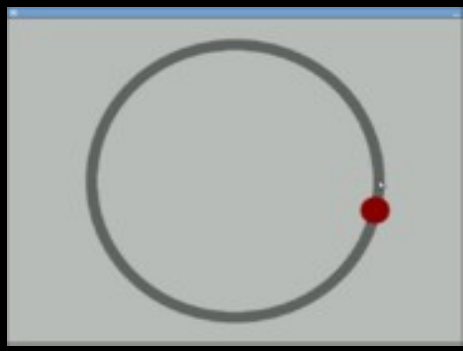

Connections task

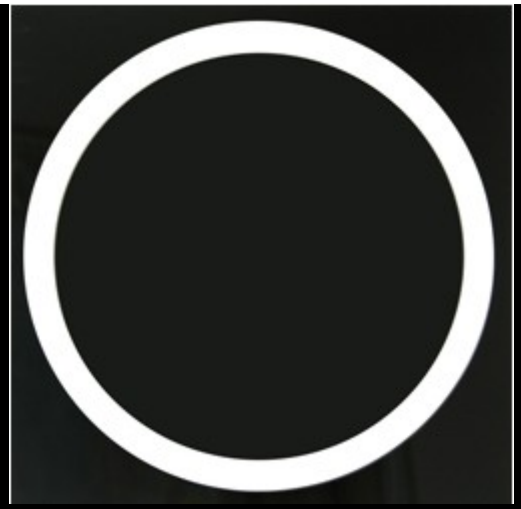



http://pebl.sf.net

# Rotary Pursuit

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





Lafayette Instrument.

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- Standalone Psych Assessment

Related Categories

Hand-Eye Coordination

**Photoelectric Rotary Pursuit**

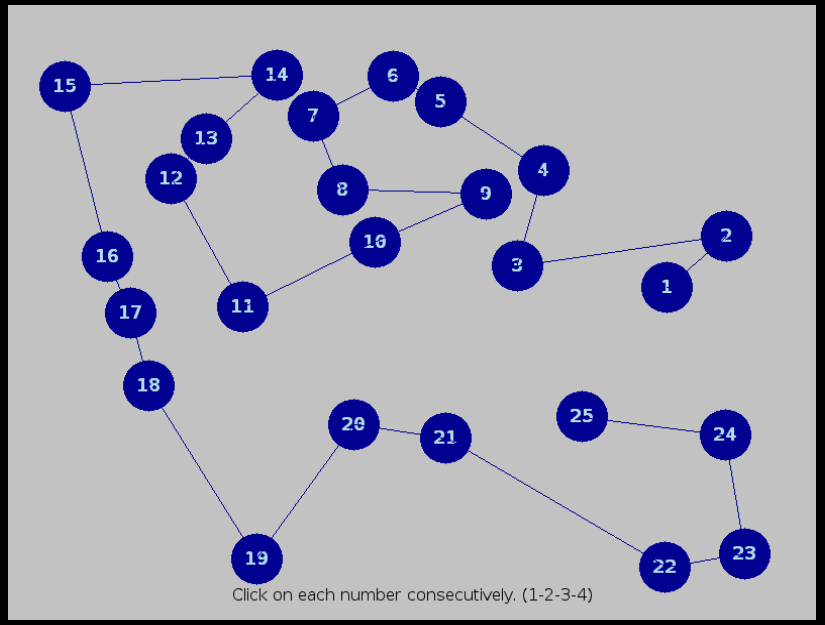
**Model 30014B**

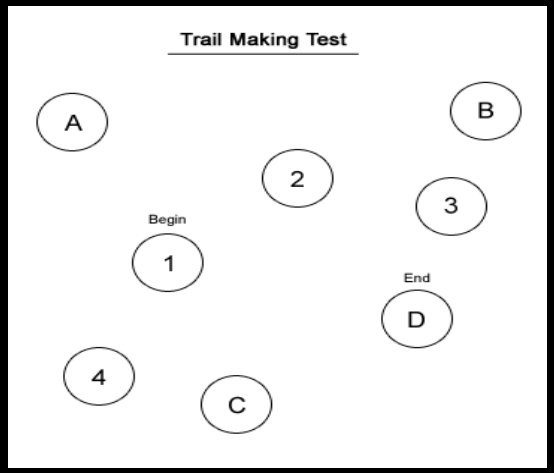
Price: $ 2495.00*

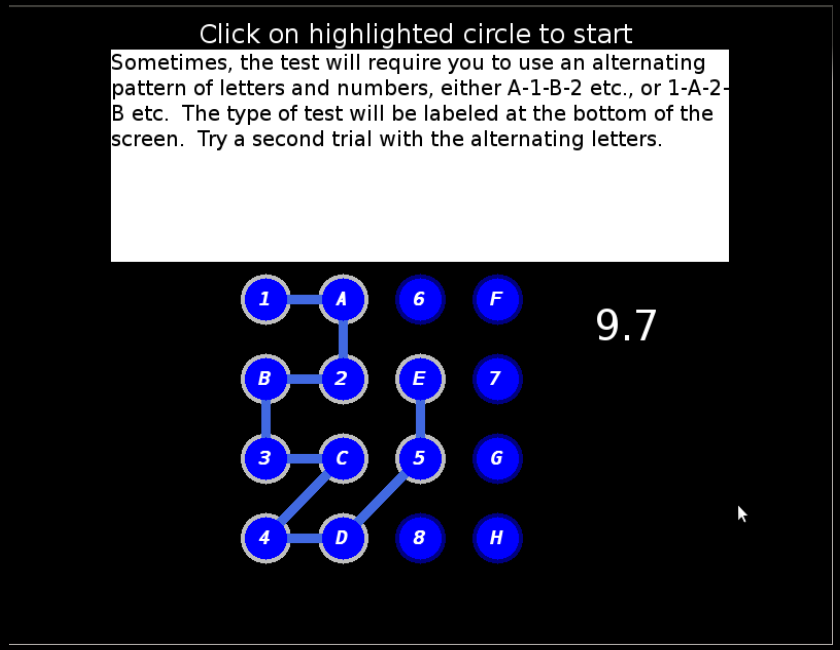
*Price for US Customers only, please login/register for international pricing

# Trail Making Test

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



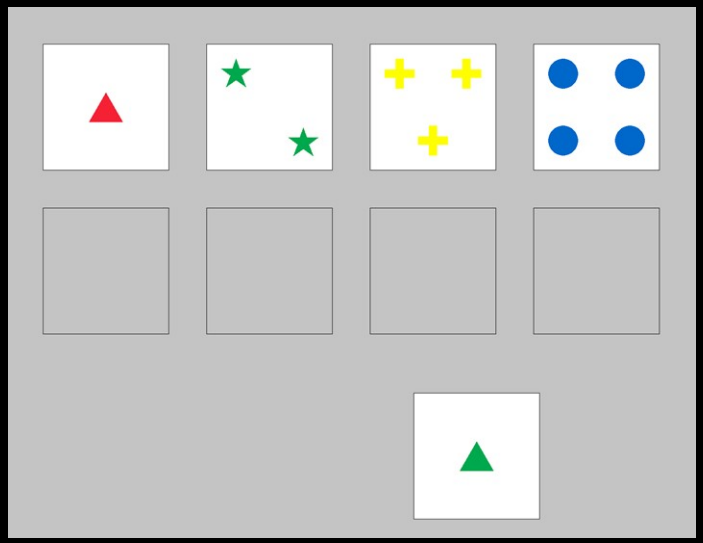



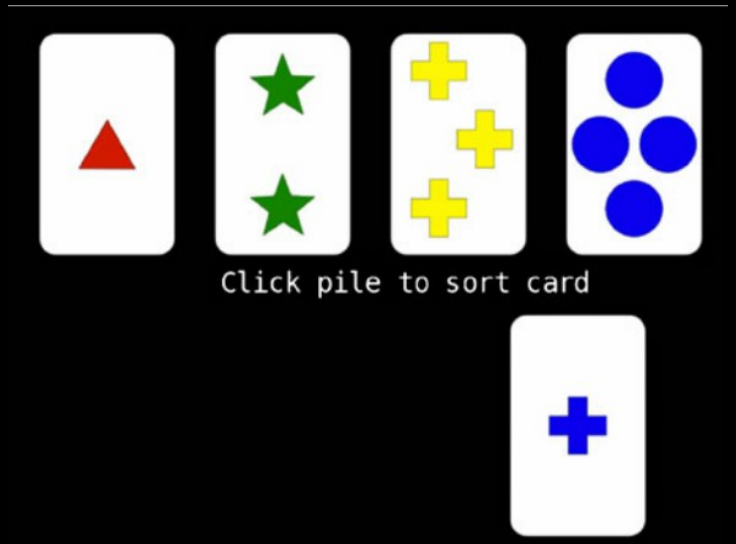
# Wisconsin Card Sorting Test

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

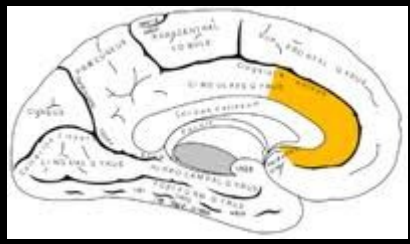
Psychological Assessment Resources
Wisconsin Card Sort Test ($675)



Psychology Experiment Building Language
Berg Card Sort Test

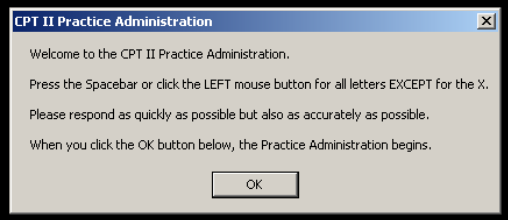


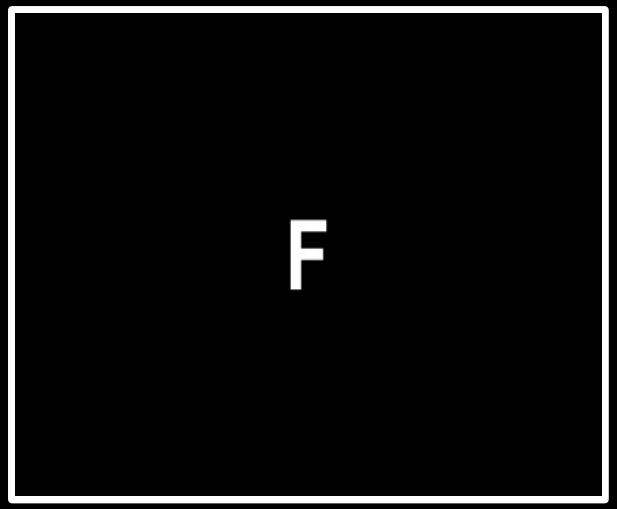
# Continuous Performance Test



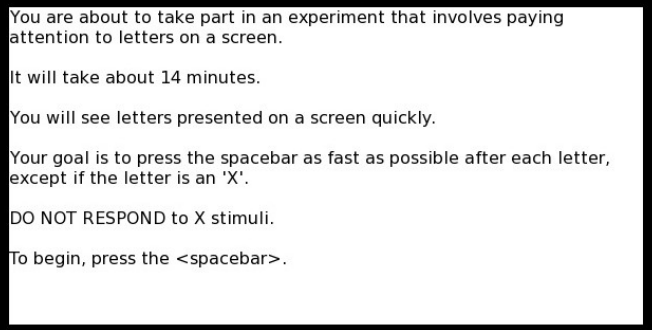
- Sustained attention & vigilance
- Many variations including Conners' CPT

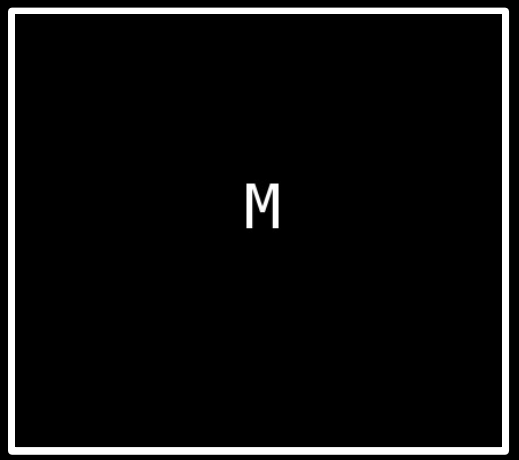
Pearson Assessments ($749)




PEBL CPT



# 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. British Journal of Surgery, 98, 1666-1672.
- Clark, D. G., & Kar, J. (2011). Bias of quantifier scope interpretation is attenuated in normal aging and semantic dementia. Journal of Neurolinguistics, 24, 411-419.
- Danckert, J., Stöttinger, E., Quehl, N., & Anderson, B. (2011). Right hemisphere brain damage impairs strategy updating. Cerebral Cortex.
- 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. Neuropsychologia, 48, 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. Aviation, Space, & Environmental Medicine, 80(12), 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. Addictive Behaviors, 35 (11), 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. Psychonomic Bulletin & Review, 15(3), 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. Neuropharmacology, 61(5-6), 950-956.
- Piquet, M., Balestra, C., Sava, S., & Schoenen, J. (2011). Supraorbital transcutaneous neurostimulation has sedative effects in healthy subjects. BMC Neurology, 11(1), 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 SpecialtyAuto-mated
- PAR's assertion of copyright over such tests (includ-ing 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

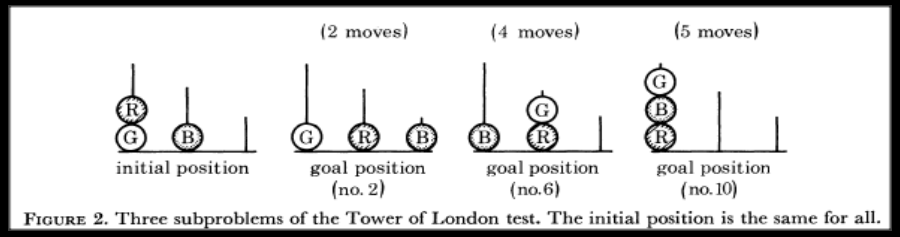
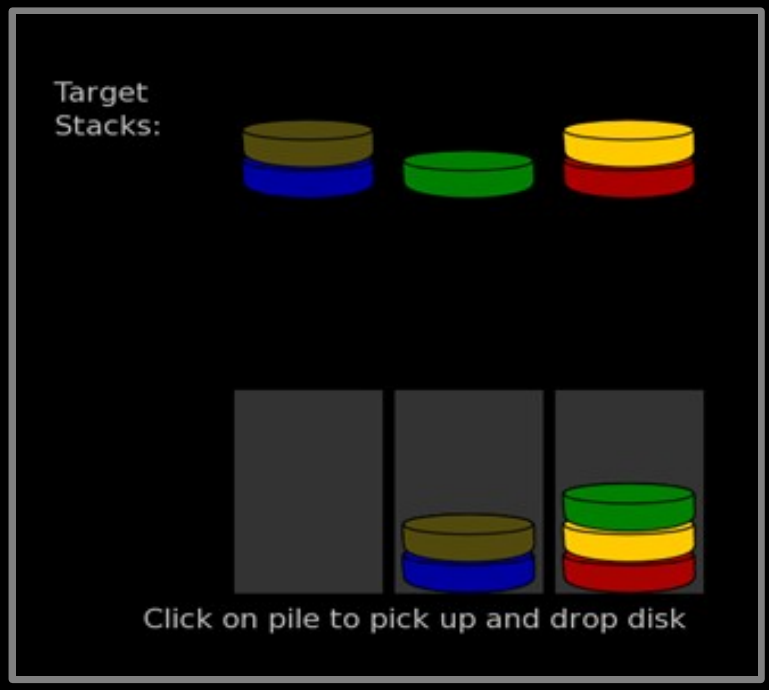


FIGURE 2. Three subproblems of the Tower of London test. The initial position is the same for all.



# *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 |