

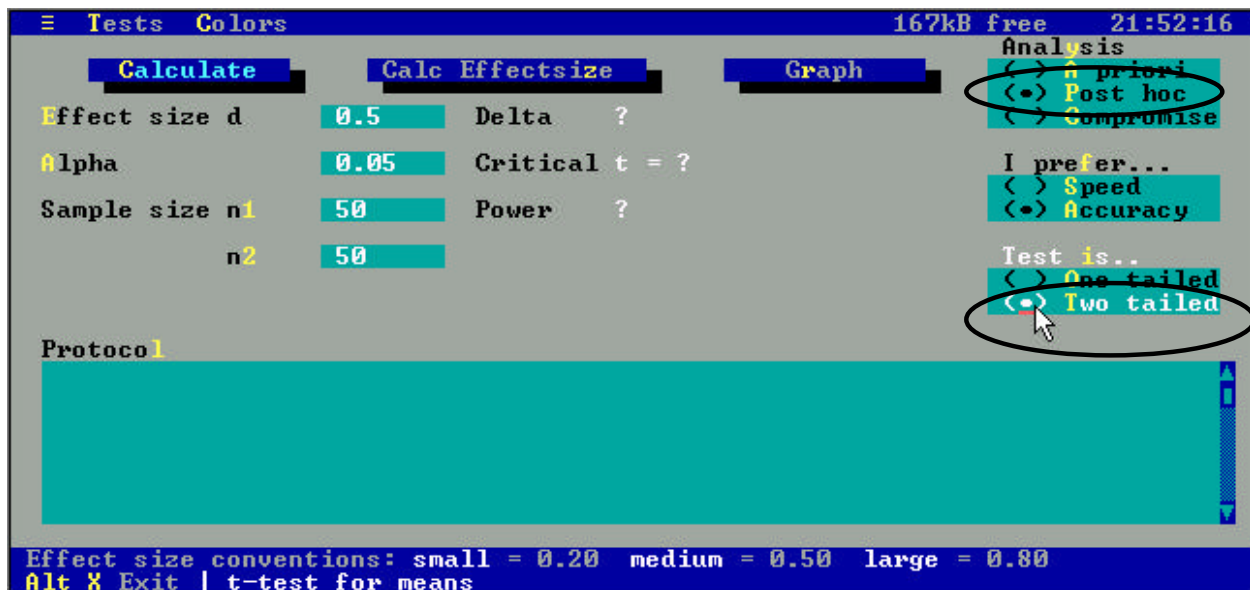
## Calculating Power using G\*Power

In this tip sheet we will depart from using Excel and introduce a program called G\*Power. Using G\*Power, we will be able to conduct both a priori and post hoc power analyses. Our example will focus on a scenario in which the appropriate statistical analysis is an independent groups t test, but G\*Power can be used to compute power for a variety of statistical tests, including other t tests, F tests, and  $\chi^2$  tests. G\*Power is available for free in Windows and Macintosh versions from the following website:

<http://www.psych.uni-duesseldorf.de/aap/projects/gpower/>

### The Ingredients

Recall that in order to calculate power by hand we need to know the sample size (N), the alpha level ( $\alpha$ ), and the effect size ( $d$  or  $g$  for a t test). Fortunately, G\*Power requires the same information but allows us to avoid the complicated arithmetic involved in a hand calculation. G\*Power will also calculate the effect size when given two sample means and a standard deviation. We will begin our investigation of G\*Power by performing a post hoc power analysis. Below is an image of G\*Power's interface. Make sure to select "Post hoc" in the "Analysis" box and "Two tailed" in the "Test is.." box. Make selections with the mouse.

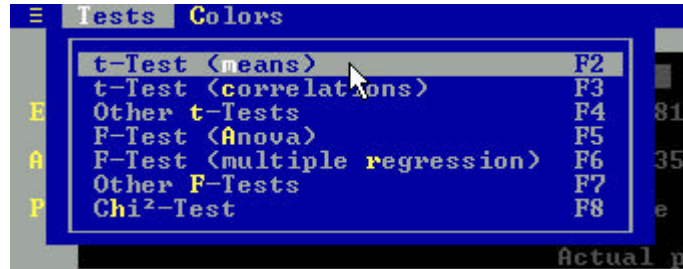


The example scenario involves a developmental psychologist studying adolescents and adults. The researcher has hypothesized that adults are better able to generate consequences for actions than are teens. The difference between the means was not significant,  $t_{58} = 1.93$ ,  $p = 0.06$ . The means, estimated pooled standard deviation, and sample size are given below. Note that N represents the number of participants in each group.

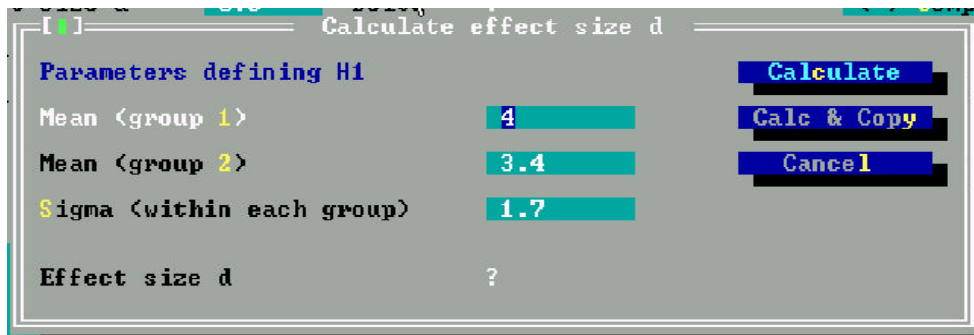
$$\begin{aligned}\bar{X}_{\text{parents}} &= 4.0 \\ \bar{X}_{\text{teens}} &= 3.4 \\ s_p &= 1.7 \\ N &= 60\end{aligned}$$

# SAMLab Tip Sheet #11

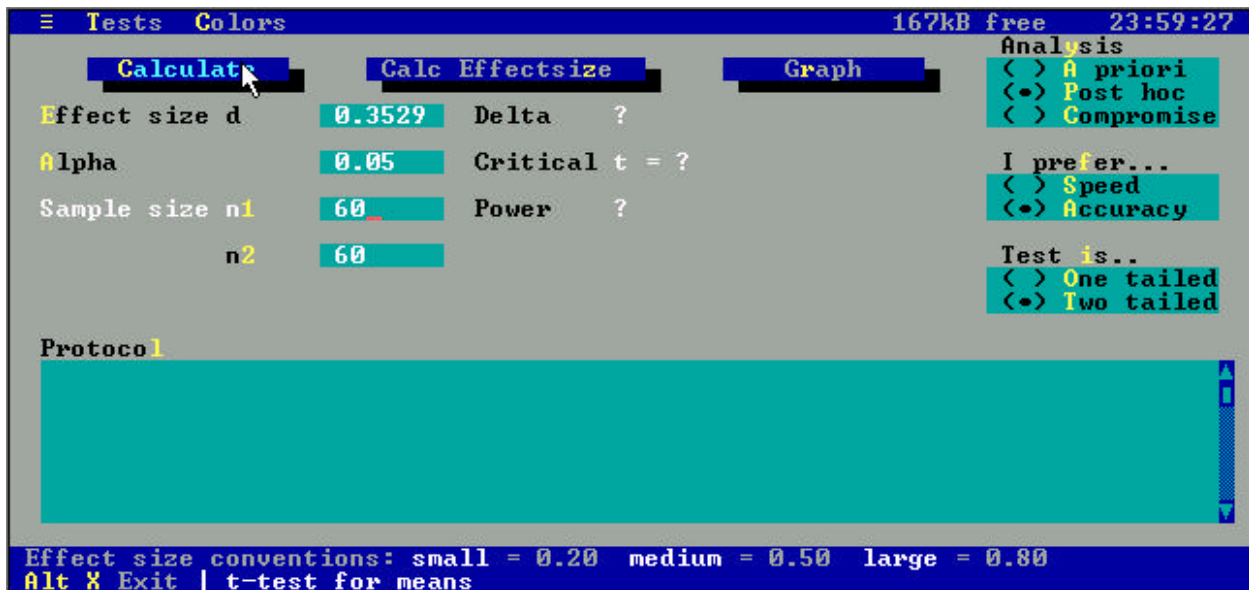
The first step in conducting our power analysis is to select “t-Test <means>” from the “Tests” menu as shown below.



The next step in conducting a post hoc power analysis is to compute the effect size. Begin by clicking the “Calc Effectsize” button. You should see a screen similar to the one below. Input the adults’ mean for group 1 and the adolescents’ mean for group 2. Sigma is our estimated pooled standard deviation. After entering the data, click “Calc & Copy.”



You should now see a screen similar to the one below. Input the sample sizes as shown. Make sure that “Accuracy” is selected in the “I prefer...” box and click the “Calculate” button.



After clicking “Calculate,” your “Protocol” box should look like the one below. If the researcher’s results represent the actual difference between the means, what was her probability of correctly rejecting the null hypothesis before collecting data? Does that seem adequate?

```

Protocol
----- T-TEST FOR MEANS, POST HOC ANALYSIS, ACCURACY MODE -----
Effect size d=0.3529, Alpha=0.05, Sample sizes n1=60, n2=60, two-tailed
Power=0.4830, Critical t(118)=1.9803, Delta=1.9329
    
```

Now we will conduct an a priori power analysis using the same example to determine what sample size the researcher would have needed to have power of 0.80 if the smallest effect size in which she is interested is  $d = 0.3$ . Our first step is to select “A priori” from the “Analysis” box. Next we will change our effect size to 0.3 and our Power to 0.8. When your interface resembles the one below, click the “Calculate” button.

The screenshot shows the SAMLab software interface. At the top, there are menu options: "Tests", "Colors", "167kB free", and "00:12:57". Below the menu, there are three buttons: "Calculate" (highlighted with a mouse cursor), "Calc Effectsize", and "Graph". To the right of these buttons is the "Analysis" section with three radio button options: "A priori" (selected), "Post hoc", and "Compromise". Below the buttons, there are input fields for "Effect size d" (0.3), "Alpha" (0.05), and "Power" (0.8). There are also labels for "Delta ?", "Critical t = ?", "Total sample size ?", and "Actual power ?". At the bottom right, there is a "Test is.." section with two radio button options: "One tailed" and "Two tailed" (selected). Below the input fields is the "Protocol" box, which contains the following text:

```

Protocol
----- T-TEST FOR MEANS, POST HOC ANALYSIS, ACCURACY MODE -----
Effect size d=0.3529, Alpha=0.05, Sample sizes n1=60, n2=60, two-tailed
Power=0.4830, Critical t(118)=1.9803, Delta=1.9329
    
```

At the very bottom of the interface, there is a status bar with the text: "Effect size conventions: small = 0.20 medium = 0.50 large = 0.80" and "Alt X Exit | t-test for means".

Your “Protocol” box should now look like the one below. The sample size given is the total number of participants required. Are you surprised she needs 176 participants in each condition?

```

Protocol
----- T-TEST FOR MEANS, POST HOC ANALYSIS, ACCURACY MODE -----
Effect size d=0.3529, Alpha=0.05, Sample sizes n1=60, n2=60, two-tailed
Power=0.4830, Critical t(118)=1.9803, Delta=1.9329
----- T-TEST FOR MEANS, A PRIORI ANALYSIS, ACCURACY MODE -----
Effect size d=0.3, Alpha=0.05, Power=0.8, two-tailed
Total sample size=352, Critical t(350)=1.9668, Delta=2.8142
    
```