V REVIEW OF STATISTICAL POWER

The power of a statistical measure is defined as the probability of a significant observation *given* that an effect hypothesis (H_1) is true. Define the value of a dependent variable as X. Then, given that the null hypothesis (H_0) is true, a significant observation, x, is defined as one in which the probability of observing

$$x \geq \mu_0 + 1.645\sigma_0,$$

where μ_0 and σ_0 are the mean and standard deviation of the parent H_0 distribution, is less than or equal to 0.05.

Figure 3 shows these definitions in graphical form under the assumption of normality. The *Z-Score* is a normalized representation of the dependent variable and is given by:

$$z = \frac{(x - \mu_0)}{\sigma_0},$$

where x is the value of the dependent variable and μ_0 and σ_0 are the mean and standard deviation, respectively, of the parent distribution under H_0, and z_c is the minimum value (i.e., 1.645) required for significance (one-tailed). The mean of z under H_0 is zero. The mean and standard deviation of z under H_1 are μ_{AC} and σ_{AC}, respectively.

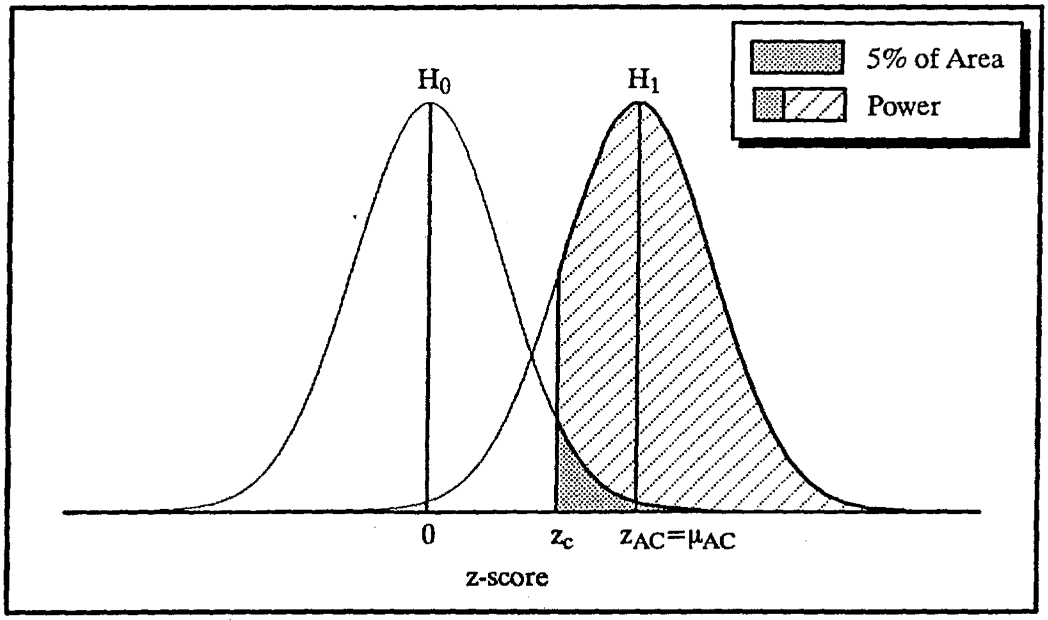

Figure 3. Normal Representation of Statistical Power

In general the effect size, ε, may be defined as:

$$\varepsilon = \frac{z}{\sqrt{n}}, \tag{3}$$

where n is the sample size. Let ε_{AC} be the empirically derived effect size for anomalous cognition (AC). Then $z_{AC} = \mu_{AC}$ in Figure 3 is computed from Equation 3. From Figure 3 we see that power is defined by:

$$\text{Power} = \frac{1}{\sigma_{AC}\sqrt{2\pi}} \int_{z_C}^{\infty} e^{-0.5\left(\frac{\varsigma - \mu_{AC}}{\sigma_{AC}}\right)^2} d\varsigma . \tag{4}$$

Let

$$z = \frac{\varsigma - \mu_{AC}}{\sigma_{AC}} .$$

Then Equation 4 becomes

$$\text{Power} = \frac{1}{\sqrt{2\pi}} \int_{z'_c}^{\infty} e^{-0.5z^2} dz, \quad where\ z'_c = \frac{z_c - \mu_{AC}}{\sigma_{AC}} . \tag{5}$$

For planning purposes, it is convenient to invert Equation 5 to determine the number of trials that are necessary to achieve a given power under the H_1 hypothesis. If we define z(P) to be the z-score associated with a power, P, then the number of trials required is given by:

$$n = \frac{4z^2(P)}{\varepsilon_{AC}^2}, \tag{6}$$

where ε_{AC} is the estimated mean value for the effect size under H_1. Figure 4 shows the power, calculated from Equation 5, for various effect sizes for $z_c = 1.645$.

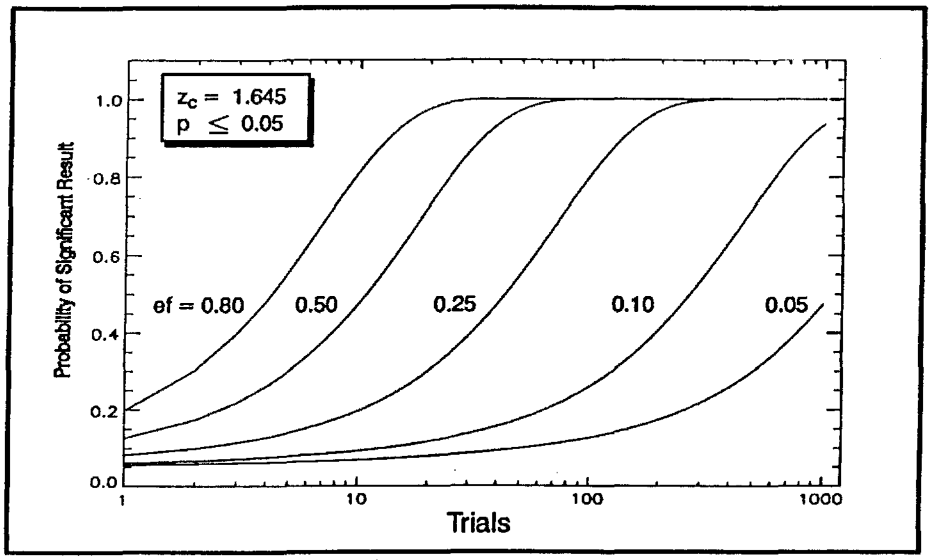

Figure 4. Statistical Power for Various Effect Sizes