3.4 STRENGTH OF ASSOCIATION[12]

Although significance testing, comparisons, and parameter estimation help illuminate the nature of group differences, they do not assess the degree to which the IV(s) and DV are related. It is important to assess the degree of relationship to avoid publicizing trivial results as though they had practical utility. As discussed in Section 3.1.2, overly powerful research sometimes produces results that are statistically significant but realistically meaningless.

Strength of association assesses the proportion of variance in the DV that is associated with levels of an IV. How much of the total variance in the DV is predictable from knowledge of the levels of the IV? If the total variances of the DV and the IV are represented by circles, how much do the circles overlap? Statistical significance testing assesses the *reliability* of the association between the IV and DV. Strength of association measures *how much* association there is.

A rough estimate of strength of association is available for any ANOVA through η^2 (eta squared).

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} \tag{3.25}$$

When there are 2 levels of the IV, η^2 is the (squared) point biserial correlation between the continuous variable (the DV) and the dichotomous variable (the two levels of the IV).[13] After finding a significant main effect or interaction, η^2 shows the proportion of variance in the DV (SS_{total}) attributable to the effect (SS_{effect}). In a balanced, equal-*n* design, η^2's are additive; the sum of η^2 for all significant effects is the proportion of variation in the DV that is predictable from knowledge of the IVs.

This simple, popular measure of strength of association is flawed for two reasons. The first is that η^2 for a particular IV depends on the number and significance of other IVs in the design. η^2 for an IV tested in a one-way design is likely to be larger than η^2 for the same IV in a two-way design where the other IV and the interaction

[12] This is also called effect size or treatment magnitude.

[13] All strength of association values are associated with the particular levels of the IV used in the research and do not generalize to other levels.

From: Tabachnick, B.G., + Fidell, L.S. (1989). Using multivariate statistics, 2nd Ed. New York: Harper Co

add to the total variance, especially if one or both of the additional effects is large. This is because the denominator of η^2 contains systematic variance for other effects in addition to error variance and systematic variance for the effect of interest.

Therefore, an alternative form of η^2 is available where the denominator contains only variance attributable to the effect of interest plus error

$$\eta^2_{alt} = \frac{SS_{effect}}{SS_{effect} + SS_{error}} \tag{3.26}$$

With this alternative, η^2's for all significant effects in the design *do not* sum to proportion of systematic variance in the DV. Indeed, the sum is sometimes greater than 1.00. It is imperative, therefore, to be clear in your report when this version of η^2 is used.

A second flaw is that η^2 describes proportion of systematic variance in a sample with no attempt to estimate proportion of systematic variance in the population. A statistic developed to estimate strength of association between IV and DV in the population is ω^2 (omega squared).

$$\omega^2 = \frac{SS_{effect} - (df_{effect})(MS_{error})}{MS_{error} + SS_{total}} \tag{3.27}$$

This is the additive form of ω^2 where the denominator represents total variance, not just variance due to effect plus error, and is *limited to between-subjects analysis of variance designs with equal n*. Forms of ω^2 are available for designs containing repeated measures (or randomized blocks) as described by Vaughn and Corballis (1969).

A separate measure of strength of association is computed and reported for each statistically significant main effect and interaction in a design.