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Measuring the Strength of the Effect of Violent Media on Aggression

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In our *American Psychologist* article (June–July 2001), we presented a figure that compared the effect of violent media on aggression with other well-known effects (Bushman & Anderson, 2001, Figure 2, p. 480). Because the strength of the relationship between violent media and aggression is unclear to many people, it is quite useful to compare it with other relationships with which people are more familiar (e.g., the relationship between cigarette smoking and lung cancer). For example, *Youth Violence: A Report of the Surgeon General* contains a table of correlations showing that TV violence is a larger risk factor for violence among children 6–11 years old than other well-known violence risk factors such as low IQ, being from a broken home, having abusive parents, and having antisocial peers (U.S. Department of Health and Human Services, 2001, Table 4-1).

It is necessary, of course, to convert different effect-size indices to a common index so that people can more easily compare effects. We chose the correlation coefficient because it is familiar to many people. For some of the effects reported in our Figure 2 (Bushman & Anderson, 2001, p. 481), we converted odds ratios to correlations. In their critique of our article, Block and Crain (2007, this issue) claimed, "There is no data transformation that converts an odds ratio or relative risk into a correlation" (p. 252). They further stated that our transformation method is "wrong" and "faulty" (p. xxx). They are incorrect. In fact, there are many different methods for transforming an odds ratio or relative risk into a correlation. We used the following transformation proposed by Digby (1983): $(OR^{3/4} - 1) / (OR^{3/4} + 1)$, where OR is the odds ratio. Bonett (2007, this issue) provides a brief review of methods that transform a relative risk or odds ratio into a correlation.

Block and Crain (2007) also stated that at least 6 of the 9 comparison correlations shown in Figure 2 of our 2001 article were calculated incorrectly. Of course, different transformations will likely yield different estimates, but in the present case the different estimates generally do not vary that much. Block and Crain cited one example where their estimate varies greatly from our estimate. To create the bar in our Figure 2 that gives the correlation between cigarette smoking and lung cancer, we used data from Figure 1 (based on 100 male patients with lung cancer and 186 male patients with other chest diseases; total $N = 286$) and Figure 3 (based on 605 patients with lung cancer and 780 male patients in the general hospital population without lung cancer; total $N = 1{,}385$) in Wynder and Graham's (1950) classic article. The phi coefficients computed from their Figures 1 and 3 are .35 and .41, respectively. In our 2001 article, we computed a weighted average of these two coefficients (i.e., $[.35 \times 286 + .41 \times 1{,}385] / [286 + 1{,}385] = .40$). The same estimates we reported have also been reported by other researchers (e.g., Eron, 1996; Huesmann in *Violence on Television*, 1993).

Table 1 shows the calculations based on Figure 3 of Wynder and Graham's (1950) article. The frequency procedure in SAS yields the following correlations: phi coefficient = .41, Spearman correlation = .40, Pearson product–moment correlation coefficient = .40. The phi coefficient assumes dichotomous data, the Spearman correlation assumes ordinal data, and the Pearson correlation assumes interval data.

Block and Crain (2007) criticized our approach to computing the correlation between cigarette smoking and lung cancer on two grounds. First, they stated (p. 252), "Wynder and Graham's (1950) Figure 1 (p. 332) is a subset of their Figure 3 (p. 333). It is wrong to pool the data from these two figures; cases are counted twice." This statement is simply incorrect. In the paragraph titled "Comparison of *Independent* Studies" (p. 332, emphasis added), Wynder and Graham (1950) stated, "Before the smoking habits of the 605 patients with cancer of the lungs are compared with those of the general hospital population, it might be well to compare the results of two control studies" (p. 332). The data in Wynder and Graham's Figure 1 are from Control Study I.

Table 1
Percentages for Amount of Smoking Among 605 Male Patients With Lung Cancer and 780 Male Patients Without Lung Cancer

Amount of smoking	Cancer %	Cancer *n*	No cancer %	No cancer *n*
None	1.3	8	14.6	114
Light	2.3	14	11.5	90
Moderate	10.1	61	19.0	148
Heavy	35.2	213	35.6	278
Excessive	30.9	187	11.5	90
Chain	20.3	123	7.6	59

Note. Data are from Figure 3 in Wynder and Graham (1950). The sum of counts of men with cancer equals 606 rather than 605 owing to rounding error. The sum of counts of men without cancer equals 779 rather than 780 owing to rounding error. None = less than 1 cigarette per day for more than 20 years; light = 1–9 cigarettes per day for more than 20 years; moderate = 10–15 cigarettes per day for more than 20 years; heavy = 16–20 cigarettes per day for more than 20 years; excessive = 21–34 cigarettes per day for more than 20 years; chain = 35 or more cigarettes per day for more than 20 years.

Second, Block and Crain (2007, p. 252) stated that our estimate is inaccurate:

> We repeated the calculation, using just Figure 3 from Wynder and Graham (1950). In doing so, we defined one variable as the amount of smoking the patients engaged in, as coded in Table 2 (p. 331) of Wynder and Graham (1950). The second variable was a diagnosis of lung cancer versus other diagnoses. The resulting correlation was .90, not .40 as reported by Bushman and Anderson (2001, Figure 2, p. 481).

We could not replicate the .90 correlation that Block and Crain (2007) computed, but we suspect it is inaccurate. The correlations we computed for Figure 3 ranged from .40 to .41. A .90 correlation suggests that 81% ($.90^2$) of the variance in lung cancer is attributable to smoking cigarettes. This leaves little room for other factors to influence lung cancer (e.g., diet, exercise, genetic predispositions).

Regarding our own meta-analysis, Block and Crain (2007) stated that we "did not provide references for the studies included in their meta-analysis; therefore it is impossible to replicate their study or determine if they again used the faulty transformation to convert odds ratios and relative risk to correlation coefficients" (p. 252). We did not include references for the studies in our meta-analysis because the editor of *American Psychologist* thought it would be better to have interested individuals contact us directly for these references rather than to use valuable journal space listing hundreds of references. These references are readily available from Brad J. Bushman.

We do agree with Block and Crain's (2007) conclusion that violent media effects constitute an important and controversial topic and that the results from scientific studies on media-related aggression need to be accurate and replicable. Our 2001 article relied heavily on meta-analytic procedures to integrate the literature on media-related aggression. Meta-analytic procedures are more objective, accurate, and replicable than are traditional narrative procedures (e.g., Bushman & Wells, 2001; Cooper & Rosenthal, 1980). Although violence in the media is not the only factor that increases aggression, or even the most important factor, it is not a trivial factor.

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Transforming Odds Ratios Into Correlations for Meta-Analytic Research

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Block and Crain (2007, this issue) stated, "There is no data transformation that converts an odds ratio or relative risk into a correlation. One needs more data" (p. 252). The purpose of this comment is to explain how an odds ratio or relative risk can be transformed to *approximate* a product–moment correlation. Such transformations have important applications in meta-analytic research.

Meta-analysis often involves the combination of product–moment correlations obtained from multiple published studies. A product–moment correlation between two quantitative variables (X and Y) is commonly referred to as a *Pearson correlation*. If one variable is *naturally dichotomous* (male/female, Treatment A/Treatment B, etc.) while the other variable is quantitative, the product–moment correlation between X and Y is called a *point-biserial correlation*. If both X and Y are naturally dichotomous, the product–moment correlation between X and Y is called a *phi coefficient*.

In contrast to naturally dichotomous variables, quantitative variables are sometimes measured on dichotomous scales. For instance, in survey research, where certain questions are of a sensitive nature (e.g., income, alcohol consumption, body weight), the response rate is often higher if the respondent is simply asked to check one of two broad categories (e.g., less than $40,000 per year, $40,000 or more per year) rather than a specific quantitative value. In other applications, genetic or psychometric theory predicts the existence of a latent quantitative variable that is observable only on a dichotomous scale as a result of the latent variable exceeding, or not exceeding, some unknown threshold value. Quantitative variables that are measured on dichotomous scales are referred to as *artificially dichotomous*.

Table 1
2 × 2 Contingency Table

	y_1	y_2	
x_1	p_{11}	p_{12}	p_{1+}
x_2	p_{21}	p_{22}	p_{2+}
	p_{+1}	p_{+2}	

When X and Y are naturally or artificially dichotomous, data from a sample of n respondents may be summarized in a 2 × 2 contingency table as shown in Table 1, where p_{ij} are the cell proportions, p_{i+} is a marginal row proportion, and p_{+j} is a marginal column proportion. The association in a 2 × 2 contingency table is often reported in terms of an *odds ratio,*

$$\mathrm{OR} = (p_{11}p_{22})/(p_{12}p_{21}),$$

or a *relative risk,*

$$\mathrm{RR} = (p_{11}/p_{1+})/(p_{21}/p_{2+}),$$

where X is the predictor variable and y_1 is the response category of interest. A relative risk may be transformed into an odds ratio using the following equality:

$$\mathrm{OR} = \mathrm{RR}\{(1 - p_{21}/p_{2+})/(1 - p_{11}/p_{1+})\}.$$

In applications where the response category (y_1) is rare, note that p_{11} and p_{21} may be very small so that $p_{1+} \approx p_{12}$, $p_{2+} \approx p_{22}$, and thus RR ≈ OR.

The problem of estimating the Pearson correlation between two quantitative variables using information from a 2 × 2 contingency table is one of the oldest problems in statistics (Pearson, 1900) and involves the computation of a *tetrachoric correlation*. The computation of the exact tetrachoric correlation is complicated but may be obtained in the current version of SAS. If a study reports the odds ratio but does not provide enough additional infor-