# A Criterion-Specific Advantage for Small Samples in the Detection of Correlation


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The present work examines the counterintuitive hypothesis that small samples provide better grounds for inferring the existence or non-existence of a population correlation than do larger samples. Researchers have long cited *capacity limitation* as an explanation for sub-optimal performance (e.g., Miller, 1956; Broadbent, 1958). Yet, recent work (e.g., Kareev, 2000) has challenged the notion that more information is always better—and this challenge takes place in the domain of correlation detection which is, without question, fundamental to learning and cognition. Kareev (e.g., Kareev, 2000) noted that the sampling distribution of the Pearson correlation coefficient is skewed, and that the amount of skew increases as $n$ (the number of elements in *each sample*) decreases. The *top half* of Figure 1 illustrates two such distributions ($n$ = 5 and $n$ = 10) sampled from a population with a correlation ($\rho$) of .56.

Consistent with Kareev's analyses (e.g., Kareev, 2000), the median and modal correlation (*r*) in the top half of Figure 1 exceed the value of $\rho$, and the proportion of sample *r*s exceeding an arbitrary criterion, $c$ (the rightmost dashed line in the top half of the figure) is greater when $n = 5$ than when $n = 10$. Thus, there appears to be a small-sample advantage for inferring whether $\rho = 0$ or $\rho > 0$.

One feature of Kareev's work, as well as later work by Juslin and Olsson (2000), is that the decision criterion is used not to decide whether $\rho = 0$ or $\rho > 0$, but to distinguish "useful" correlations from correlations that are too small to be predictively useful (see Kareev, 2000).

In contrast to previous research, we built a simulation that used a straightforward means of defining various types of correct and incorrect inferences about $\rho$. Using a signal detection paradigm, we included samples drawn from populations in which $\rho = 0$, as well as from populations in which $\rho > 0$. A false alarm occurred when $\rho = 0$ and when the sample correlation ($r$) was either greater than an arbitrary decision criterion, $c$, or less than $-c$. Likewise, a hit occurred when $\rho > 0$ and when $r$ was either greater than $c$ or less than $-c$. The criterion was manipulated across five levels (± .5, .6, .7, .8, and .9). Figure 1 shows the actual sampling distributions generated by the simulation, with the dashed lines showing $c = \pm .8$.

Performance was measured as the *hit rate minus the false alarm rate* (D), the components of which are illustrated in Figure 1 (Note that D was computed separately for $n = 5$ and $n = 10$). $H_1$, $H_2$, $F_1$, $F_2$, L, and Q denote regions of the sampling distributions, where $H_1$ and $H_2$ are *hits* (i.e., *signal* samples falling outside the range of the criteria), and $F_1$ and $F_2$ are *false alarms* (i.e., *noise* samples falling outside the range of the criteria). Thus, $D = [(H_1+H_2)/(H_1+H_2+L)] - [(F_1+F_2)/(F_1+F_2+Q)]$. The results showed that the existence of a small-sample advantage depended on the placement of $c$: When $c$ was ± .8 or ± .9, there was indeed a small-sample advantage (i.e., D was greater for $n = 5$ than for $n = 10$). But when $c$ was ± .5, .6, or .7, there was a large-sample advantage. (The findings were virtually identical when the hit and false alarm rates consisted of $H_1$ and $F_1$ only).

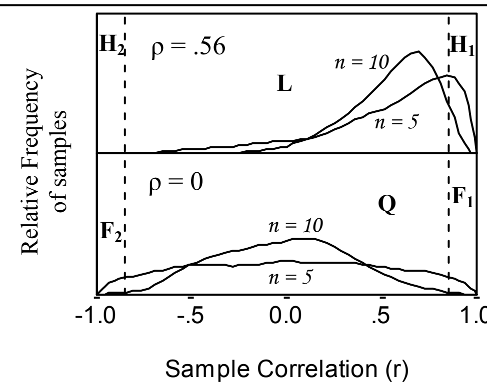


Figure 1. Sampling distributions.


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