Step 3: The null hypothesis must express equality and the alternative hypothesis cannot include equality, so we have

$$H_0: \mu_d = 0 \text{ cm} \quad H_1: \mu_d > 0 \text{ cm (original claim)}$$

Step 4: The significance level is $\alpha = 0.05$.

Step 5: We use the Student t distribution.

Step 6: Before finding the value of the test statistic, we must first find the values of $\bar{d}$ and s_d. Refer to Table 9-1 and use the differences of 19, -12, 8, 0, and 1 to find these sample statistics: $\bar{d} = 3.2$ cm and $s_d = 11.4$ cm. Using these sample statistics and the assumption of the hypothesis test that $\mu_d = 0$ cm, we can now find the value of the test statistic.

$$t = \frac{\bar{d} - \mu_d}{\frac{s_d}{\sqrt{n}}} = \frac{3.2 - 0}{\frac{11.4}{\sqrt{5}}} = 0.628$$

Because we are using a t distribution, we refer to Table A-3 to find the critical value of $t = 2.132$ as follows: Use the column for 0.05 (Area in One Tail), and use the row with degrees of freedom of $n - 1 = 4$. Figure 9-4 shows the test statistic, critical value, and critical region.

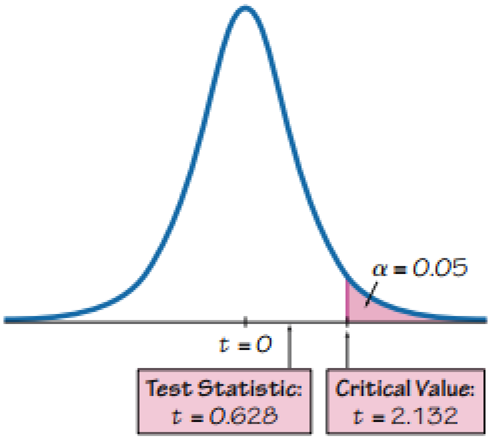

Figure 9-4 **Hypothesis Test with Dependent Samples**

Step 7: Because the test statistic does not fall in the critical region, we fail to reject the null hypothesis.

Interpretation

We conclude that there is not sufficient evidence to support $\mu_d > 0$ cm. That is, there is not sufficient evidence to support the claim that for the population of heights of presidents and their main opponents, the differences have a mean greater than 0 cm. That is, presidents do not appear to be taller than their opponents.

Example 2 **Confidence Interval for Estimating the Mean of the Height Differences**

Using the same sample data in Table 9-1, construct a 90% confidence interval estimate of μ_d, which is the mean of the differences in height. By using a confidence level of 90%, we get a result that could be used for the hypothesis test in Example 1.

Gender Gap in Drug Testing

A study of the relationship between heart attacks and doses of aspirin involved 22,000 male physicians. This study, like many others, excluded women. The General Accounting Office recently criticized the National Institutes of Health for not including both sexes in many studies because results of medical tests on males do not necessarily apply to females. For example, women's hearts are different from men's in many important ways. When forming conclusions based on sample results, we should be wary of an inference that extends to a population larger than the one from which the sample was drawn.