CI Paired Data - The Wolf Spider Example

Use the information in the following setting to answer questions 1 through 8:

Biochemical cues produced by predators can have a marked effect on prey species that have receptors for these cues. In order to assess the effect that the presence of the Chinese praying mantis had on the mobility of the native wolf spider, investigators at Miami University (Miami, OH) collected excreta from the praying mantis on filter paper. The excreta served as the biochemical cue for the spider.

The wolf spider's movement was measured in an arena (18.5 cm in diameter). The arena was fitted so that ½ of the area contained filter paper that had been treated with the cue. The other half had a clean (control) piece of filter paper. Several variables were measured while the spider was in the arena. One of these variables was the speed with which the spider moved over the different areas.


[Note: the data below are constructed from the descriptive statistics reported in the article. These are not the original data]

The raw data and Minitab output for the study are provided below:

<table>
<thead>
<tr>
<th>Table 1: Walking speeds (cm/sec) of native wolf spiders (P. milvina) on untreated (control) and treated filter paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tray #</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Difference</td>
</tr>
</tbody>
</table>

Note: the difference is computed as Control - Treatment

Descriptive Statistics: diff

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SE Mean</th>
<th>StDev</th>
<th>Minimum</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>diff</td>
<td>12</td>
<td>1.171</td>
<td>0.378</td>
<td>1.308</td>
<td>-1.173</td>
<td>-0.105</td>
<td>1.588</td>
<td>2.230</td>
<td>2.667</td>
</tr>
</tbody>
</table>

1) How can you tell that this is a paired experiment?

Each spider has two measurements.

2) What is the point estimate for the true mean difference in walking speeds?

\[ \bar{X}_d = \bar{d} = 1.171 \]

3) A current biological theory is that slower movement reduces the chances of predation. Does this experiment support (at least tentatively) that theory? Why or Why not?

Since we have a positive mean difference, where difference was control - treatment, there is some evidence that the spiders move slower around predators.
4) For a desired level of confidence of 95%, what is the t-value to be used in computing the CI?
\[ df = n - 1 = 11 \]
\[ t^* = 2.201 \]

5) Compute the 95% bound from the summary data provided for this setting
\[ M.E. = t^* \frac{s}{\sqrt{n}} = 2.201 \frac{1.308}{\sqrt{12}} = .831 \]

6) Construct a 95% CI for the true average difference in walking speeds for the wolf spider with and without the biochemical cue.
\[ CI: \hat{\mu}_d \pm M.E. = 1.171 \pm .831 = (.339, 2) \]

7) Construct a CI diagram for the interval calculated in Problem 6

8) Another entomologist claims that, even though the Praying Mantis is a natural predator for the wolf spider the biochemical cue contained in the excreta does not have any effect on the spider’s locomotion speed. Using the diagram constructed in Problem 7 agree or disagree with this claim and support your argument.

If there were truly no difference in locomotion speed, then \( \mu_d \) would be equal to 0. We are 95% confident that \( \mu_d \) is between 0.339 and 2. This suggests that the entomologist’s claim is false.