Scientific writing is by nature technical, so getting terminology and wording right is important. When there is inconsistency in definitions, or misuse of words, problems follow. Inconsistency can come about when there is no universally accepted definition for a concept or simply due to sloppiness on the author’s part.

But this is more than just a problem of semantics; when the same words are used to describe different concepts, study results can be easily and unknowingly misinterpreted.

Inconsistency is common when describing outcomes. Outcomes, whether assessed at baseline, during or post treatment, or at follow-up, can be measured in various ways. But there is a critical division that is always relevant, and interpreting the findings of a study is not possible unless the reader understands which side of a metaphorical fence the numbers are on. The 2 sides of this fence can be called change and difference.

The distinction between change and difference is critical with respect to interpreting the results of studies of treatment effectiveness. 2 types of findings give the reader different kinds of information.

### Change

Put simply, change is the score on an outcome measure (eg, at follow-up) minus the score on the same measure at an earlier time point (eg, at baseline). This is change within a person, or mean change within a group of people over time. The problem comes when within-group mean change is called the “treatment effect” or the “response to treatment.”

As mentioned in a previous Evidence in Practice article, change from baseline to follow-up includes changes due to the natural history of the condition, regression to the mean, nonspecific effects, and the effect of treatment. This isn’t the place to go into the intricacies of all these, but suffice it to say that all are relevant, regardless of the condition and the treatment; that is, this applies to every study! Within-group change over time is not the same as the treatment effect. Often, a person with a large change in outcome is called a responder to treatment A, but this language is misleading, too, because it is very likely that the same person would also be a responder to treatment B. This is basic stuff, but it is extremely tempting to attribute all the observed change to the treatment, and terms such as treatment effect, treatment response, and responder feed the temptation. This is not to say that change scores do not provide useful information. They are an estimate of what is likely to happen when a patient gets the study treatment, but they are different from the treatment effect and are not the treatment response.

### Difference

Difference requires data from 2 groups of people. The between-group difference is the mean score on an outcome measure in treatment group A minus the mean score in group B. Typically, it is either the difference between scores at follow-up or the difference in change between the 2 groups. The difference can reasonably be called the treatment effect or treatment response, because (assuming the study is well designed) the size of the difference does not include natural history, regression to the mean, and nonspecific effects. Critically, the “treatment effect” is a comparative effect. It is what can be expected if a patient got treatment A compared to what can be expected if that patient got treatment B. So, the “effectiveness” of (or response to) treatment A, as reported in a particular study, is interpreted in the light of what treatment B involved. The difference in outcome scores between groups quantifies the treatment effect (FIGURE).

Things become tricky here for readers of research because authors sometimes report conclusions based on within-group changes in randomized controlled trials (RCTs). This usually happens when there is no difference between the groups. For example, they might conclude that...
treatment A is effective, or that both treatment A and treatment B are effective, based on within-group improvements. Stating that both treatments are effective is almost never a valid conclusion from an RCT, except in some very special circumstances. Within-group change in an RCT is no more the “treatment effect” than are the results from a single-group (uncontrolled) study: it still includes natural history, regression to the mean, and nonspecific effects. Interpreting the findings of an RCT in this way defeats the purpose of randomization and having a comparison group.

**In Sum**
When reading the results of a study, you need to be able to answer the question of whether the authors are talking about a within-group change or a between-group difference. The former includes natural recovery, regression to the mean, nonspecific effects, and treatment effects. The latter is the treatment effect.

Most of the time, the information necessary to answer the question is in the study methods and requires a working knowledge of how the study was performed, and what different methods and analyses can tell us. The important thing for someone reading an article is not so much identifying whether an author is using “correct” language but determining the true meaning behind the words used.

### FIGURE. Change and difference.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment A mean change: 85 - 44 = 41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment B mean change: 85 - 19 = 66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-group difference (treatment effect): 44 - 19 = 25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### REFERENCES
