The Reliable Change Index

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Reliable Change Index (RC or RCI)

- This is a statistic that we can use to work out whether a change in an individual's score (e.g. before and after some intervention) is statistically significant or not (based on how reliable the measure is).
- It is defined as the change in a client's score divided by the standard error of the difference for the test(s) being used.
- It is a standardized score representing the change in a client's score on a test.

How to calculate the RC

- In words, the RC is equal to the individual's score before the intervention minus their score after the intervention then divided by the standard error of the difference of the test.

$$RC = \frac{x_2 - x_1}{S_{diff}}$$

where x_1 represents a subject's pretest score, x_2 represents that same subject's posttest score, and S_{diff} is the standard error of difference between the two test scores. S_{diff} can be computed directly from the standard error of measurement S_E according to this:

$$S_{diff} = \sqrt{2(S_E)^2}\ .$$

[This taken from Jacobson & Truax 1991]

How to calculate the RC

- This is how to work out the Standard Error of Measurement (=SEM or S_E) for a test – and also how to work out the Standard Error of the Difference (=SEdiff or S_{DIFF}) directly from a test's standard deviation and reliability.

SEM can be *estimated* using:
- **Standard deviation of test-takers' scores (s_x)**
- **Reliability of test (r_{xx})**

$$SEM = s_x \sqrt{(1 - r_{xx})}$$

$$SEdiff = s.d. \sqrt{2 - r1 - r2}$$

SEdiff = standard error of the difference
s.d. = standard deviation of test 1 = standard deviation of test 2 (because they've been standardised)
r1 & r2 = reliability of tests 1 & 2

How to use the RCI

- If the RCI is 1.96 or greater then the difference is statistically significant (1.96 equates to the 95% confidence interval).
- If the RCI is less than 1.96 then the difference is not significant.
- This is the same as saying the difference between the two scores has to be at least twice the SEdiff (to be precise, 1.96 times the SEdiff) to be significant.

Extensions of the reliable change index

- There are some extensions of the RCI that take into account practice effects (the fact that people get better the second time they do a test even if there's no change in whatever is being measured).
- The following is taken from Parsons et al (2009) *International Journal of Neuroscience*:

The RCI method used to correct for measurement error and practice effects was defined as $((X_2-X_1) - (M_2 - M_1))$/SDD, where X_1 was the observed pretest score, X_2 was the observed post-test score, SDD was the standard deviation of the group test–retest difference, M_1 was the group mean pretest score, and M_2 was the group mean post-test score. Practice effect correction involves the addition of a constant that is based upon the group-level average change (Heaton et al., 2001; Woods et al., 2006).

Extensions of the reliable change index

- All this means is that you work out the average improvement in the scores of people who done the test twice with no intervention (i.e. the improvement is just a practice effect).
- Then you subtract this number from the change in the individual's score.
- Then you divide by the Standard Error of the Difference.
- The RCI you end up with is now "corrected" for practice effects – so any significant differences in your client you find are real changes rather than just due to the fact they're doing the same test twice (see Heaton et al 2001).

References

- Heaton R K, Temkin N, Dikmen S, Avitable N, Taylor M J, Marcotte T D, Grant I, 2001 "Detecting change: A comparison of three neuropsychological methods, using normal and clinical samples" *Archives of Clinical Neuropsychology* ***16 75-91***
- Jacobson N S, Truax P, 1991 "Clinical significance: a statistical approach to defining meaningful change in psychotherapy-research" *Journal of Consulting and Clinical Psychology* ***59 12-19***
- Parsons T D, Notebaert A J, Shields E W, Guskiewicz K M, 2009 "Application of Reliable Change Indices to Computerized Neuropsychological Measures of Concussion" *International Journal of Neuroscience* ***119 492-507***