

## Reliable Change – Gerard Maassen

The assessment of intra-individual change is an important topic in various fields of psychology, for example in psychotherapy or neuropsychology research. Research into change may be directed at the assessment of the effects of intentional interventions such as psychotherapy or brain surgery, or unintentional interventions such as sports concussions, or even in the absence of an intervention – for example the effects of aging. The question of whether a *group* has changed between two assessments is readily answered with the help of current statistical tools. But the question of whether a *given person* has changed is often more relevant to a practitioner or a researcher.

For the situation where only a pretest and a posttest score on the outcome variable are available, as well as relevant additional information from a normative population (e.g., the reliability of the test), methods have been developed that can generally be described as follows. From the pretest and posttest scores, which are affected by measurement errors and possibly by effects of testing, and with the help of the additional information, an estimation of the true change is calculated. The ratio of this estimation in the numerator and a suitable standard error in the denominator is then used as a criterion, indicated by the generic name Reliable Change Index (RCI), which has the following general shape:

Here  $D_i$  is the observed change (posttest minus pretest) and  $P_i$  is an estimation of the effects of testing. When the RCI exceeds a chosen fractile of the normal distribution, in either positive or negative direction, the change is considered reliable, and more specifically, is cited as a reliable improvement or deterioration.

In the 'classical approach', no attention was paid to effects of testing ( $P_i = 0$ ). The observed difference score is taken as the numerator and the standard error of measurement of the difference score as the denominator. This approach, appearing for some time in psychometric theory (Lord & Novick, 1968; McNemar, 1962), has been re-established in the psychotherapy literature by Jacobson and Truax (1991), and is also known as the JT index. Since then, however, the question of how a RCI should be composed has been a matter of continual debate.

First, the RCI as presented by Jacobson and Truax induced confusion among neuropsychology researchers (Hinton-Bayre, 2000), since the notation of the standard error in the denominator probably had led some authors to use a deviant statistic (Temkin, Heaton, Grant & Dikmen, 1999). Second, in the view of several authors the estimation of the true change can be improved. In psychotherapy literature, particular attention has been paid to regression to the mean. Consequently, new RCIs have been introduced in which adjusted estimators dealing with this effect are taken as the numerator (Hageman & Arrindell, 1993, 1999; Hsu, 1989; Nunnally & Kotsch, 1983; Speer, 1992; Zegers & Hafkenscheid, 1994). The question of which standard errors should fit such estimators also has remained a matter of discussion.

Third, in the neuropsychology literature particularly effects of testing (e.g., practice effects) have attracted attention. Among the authors who have presented an RCI that attempts to take this phenomenon into account, Chelune, Naugle, Lüders, Sedlak and Awad (1993), and McSweeney, Naugle, Chelune and Lüders (1993) have been the most influential.

The presentation of new RCIs proves to be an ongoing affair. Our publications aim at discussing and comparing the various RCIs from a theoretical point of view. This has led to demonstrating the fallibility of several RCIs proposed in the literature, as well as presenting some adjusted RCIs.

## Publications in Dutch Journals

Maassen, G.H. (2000).  
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*Nederlands Tijdschrift voor de Psychologie en haar grensgebieden*, **55**, 56-65.

Maassen, G.H. (2003).  
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*Nederlands Tijdschrift voor Psychologie en haar grensgebieden*, **58**, 69-79

### **Publications in international journals**

Maassen, G.H. (2000).  
Kelley's Formula as a Basis for the Assessment of Reliable Change.  
*Psychometrika*, **65**, 187-197.

Maassen, G.H. (2000).  
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*Journal of Clinical and Experimental Neuropsychology*, **22**, 622-632.

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*Journal of the International Neuropsychological Society*, **10**, 888-893.

Maassen, G.H. (2005).  
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*British Journal of Sports Medicine*, **39**, 483-488.

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*British Journal of Sports Medicine*, **40**, 829-833.

Maassen, G.H., Bossema, E.R., and Brand, N. (2009).  
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*Journal of Clinical and Experimental Neuropsychology*, **31**, 339-352.