**Risk of bias in assessing Risk of Bias**

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Risk of bias in assessing Risk of Bias.

Griffiths et al. have used the Cochrane Risk of Bias tool in the first thorough review of the complex data surrounding the use of colour in helping with reading. Unfortunately for them, recent evidence indicates that the tool is not up to the job. Under double-masked conditions, agreement between judges using the Risk of Bias tool is so poor as to suggest that assessments of this kind have questionable validity. In an attempt to be constructive, I should like to offer steps that can be taken to improve Cochrane reviews, and the assessment of bias in particular. (1) Judges need to be drawn from all the relevant disciplines; (2) Readers need to be told the degree of agreement between judges, and those instances where agreement is poor need to be identified and the final decision justified; (3) Readers need to be told the pre-existing standpoint of the judges and (4) the judges should include those with opposing standpoints, declared. The last two are particularly important in controversial fields where professional opinion is split, otherwise any criticism is simply seen as one side taking a poke at the other. Without these simple precautions any review using the Risk of Bias tool is regrettably no more than a set of untraceable opinions of uncertain validity, dressed up to look like science. In the present review: (1) the disciplines were biased towards ophthalmology, with no representation from neurology or education; (2) there was evident disagreement between judges, but the reader is given no information as to the nature or extent of this disagreement; (3/4) the generally sceptical standpoint of the senior author, can be judged from his blog visualstresssceptic.blogspot.com/ and his previous publications.

The authors take as their subject of interest the effect of coloured filters on reading. It may seem counter-intuitive, but reading is in fact difficult to define. The authors appear to be using a definition in which measures of reading include comprehension of connected prose. This seems reasonable until one considers that in order to measure reading speed or accuracy one needs to take some account of the participants' pre-existing linguistic and semantic knowledge, their ability to remember what they have read, their interest in doing so, and so on. It will be readily appreciated that, against this background, effects of small changes in, for example, refractive error, would be difficult to measure. If one were to fail to show an effect of an inappropriate refraction on reading speed or accuracy using a conventional reading test, one would not be justified in concluding that refraction had no effect on reading. Instead one would use a more sensitive test, one that measured the visual aspects of reading and kept the variance due to comprehension to a minimum. The acuity chart is a case in point. So is the Wilkins Rate of Reading Test (WRRT).

The WRRT is sensitive to the effects on reading speed of refractive errors and prisms for decompensated heterophoria, and it can identify the individuals who will subsequently choose to use coloured overlays in the long term, so it has validity in the context of refraction, heterophoria and use of coloured filters. It may be subject to placebo effects, but where these have been deliberately introduced via instructional set, little effect has been measurable. It may be subject to Hawthorn effects (which are a combination of the effects of expectation on the part of both the participants and the experimenters). But any experimenter effects are likely to be small, given that both experimenters who are sceptical of the use of overlays and those who are less so have obtained similar improvement in reading speed with overlays. So it is some surprise that the authors categorise the use of the WRRT as an instance of external bias. Curiously, they do so only when the study in question reveals a beneficial effect of overlays on reading, not when it fails to do so. Both the study by Henderson et al. and that by Ritchie et al. used the WRRT, but the external bias was not
categorised as high for these studies. Indeed the study by Henderson et al. showed improvements in reading speed with overlays, improvements that are ignored.

There are several issues to disentangle: does the use of overlays result in immediate benefits in reducing symptoms and improving reading speed, and does their use result in longer term improvement in scholastic attainment? Currently there is little evidence for improvements in scholastic attainment, but this does not mean that the various immediate benefits in symptoms and reading speed are unimportant.

The review is marred by several errors of fact. For example, the authors criticise the reliability of the WRRT in the context of the statistic that 5% of children read more than 25% more quickly with an overlay. Unfortunately, they have omitted to allow for the fact that the above statistic is based upon each child reading two passages with overlays and two passages without. The reliability is higher than appears from the data that the authors use, which is based on reading only one passage. The test is usually given four times, once with the overlay, once without, again without, and finally once again with the overlay. The practitioner can then get some idea of the reliability of their measurements and any practice effects.

As might be expected in a review of this extent, there are several incorrect citations. Some are important. For example, the authors assert that psychophysical tests using gratings have not been shown to demonstrate an improvement with colour. In fact they have, in a paper by Monger et al. that they cite elsewhere.

In the General Discussion the authors make many sweeping generalisations that the reader is obliged to take on trust because the evidence is not cited. For example, the assertion “Improvements have been reported with prescribed overlays/lenses, but similar improvements are also found with placebo colours” is not supported. There is no such thing as a perfect study, and every one of the cited studies, including those few showing no effect of colour, have flaws and biases. The biases in the studies showing no effect are reported as being lower, but in my view are just as great. The wastepaper basket method of simply designating studies as having a high risk of bias and then ignoring their findings needs to be replaced by a more nuanced approach.

Are the beneficial effects of coloured filters indeed simply a reflection of placebo or experimenter effects? Within the limited resources available, there have been many attempts to find out. It would be nice to be certain, but large scale randomised controlled trials are extremely expensive and funding has not been forthcoming. Given that overlays cost very little and coloured lenses are paid for by the patient who has the chance to judge their value, one wonders whether limited resources might perhaps be better spent assessing treatments that are elective, but unlike tints, are invasive and irreversible, for example refractive surgery. If, in less benighted times, the NHS were to provide a funding mechanism to pay for precision ophthalmic tints, different considerations would obviously apply; a randomised controlled trial would nowadays be required to justify the public expenditure. There is agreement about a need for improvement and standardisation in diagnosing visual stress and recent imaging studies and a Delphi study (submitted) may come in useful. In the meantime, a proportionate approach for this non-invasive intervention continues to be a trial with inexpensive coloured overlays. In this way, the child, parent, and teacher have several months to decide for themselves whether there is a benefit.
Disclosure
Arnold Wilkins has undertaken consultancy for the following firms: Crossbow Education, iooSales and Cerium Visual Technologies. When employed by the Medical Research Council, he invented the Intuitive Colorimeter, Intuitive Overlays, Rate of Reading Test and (with Bruce Evans) the Pattern Glare Test. Under the MRC Awards to Inventors scheme he receives a proportion of royalties on sales of the Colorimeter and the Rate of Reading Test. No royalties are payable on overlays or lenses.

References