

## **An Introduction to Self-Refraction**

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This talk is a somewhat personal introduction to self-refraction from my perspective, and gives some of the historic origins of the child self-refraction study.

The first self-refraction device I am aware of in the literature is the “dynamoptometre” of Dr Cusco, a physician in Paris. Cusco filed a patent on his device on 25 February 1879 , Number 129293. The device had fluid-filled variable power lenses which, it was claimed, could be set to an accuracy of 0.01 dioptres - which is very interesting and even a little remarkable. Some more information about Cusco's device can be found in Bennett , Manufacturing Optics International 26 p 88 – 91 1973. It would be instructive to examine Cusco's device if it still exists, but my efforts to find it have not so far been successful.

My work on self-refraction started in earnest after I drew up and had manufactured for me a fluid-filled membrane lens on 13 May 1985. The lens – one of a series of prototype variable power lenses I made in 1985 - is of a simple construction and uses two thin polyester membranes and two double o-ring seals to seal and stretch the membranes – the use of two o-rings on either side of a membrane to seal and stretch the membrane is a trick which I had used in my atomic physics research since the 1970's. The double o-ring lens has the feature that if it is filled with water and sealed, and the volume of water in the lens is then changed, the surfaces of the lens change their curvature, and one has a lens of variable power. The natural thing to do with such a lens is to look through it and change the power – and when I did this in May 1985 I discovered I could correct my 1.5 dioptre myopia with very good accuracy – and this was really my introduction to self-refraction. You can see the actual prototype lens in operation if you look at <http://www.youtube.com/watch?v=r1rqgvbs9GQ> .

A natural development from a lens which one can use for self-refraction is a pair of eyeglasses equipped with two such lenses, and on 21 October 1993 I drew up and had made for me a rather clunky looking pair of self-refraction eyeglasses. They have syringes sticking out and look so peculiar that my grandson Charlie called them “cows” because the syringes look a little like horns. You can see a drawing of the device as Fig 1 in US Patent 6,096,742 and the device itself in the youtube video I mentioned earlier. Only one such device was ever made, but it was helpful in the progress toward my research on self-refraction in the following way. On 11<sup>th</sup> Feb 1994 I called Dr Bjorn Thylefors at the WHO in Geneva to ask him about the global need for eyeglasses. I followed our conversation up with a letter on 21 Feb

1994 which is perhaps interesting to look back on now because I wrote: “ I am a physicist and I have been developing ways of making adaptive lenses of good optical quality. I know from my own trials on myself that I can make an adaptive lens spectacle which may be used to correct my own vision very well, and I believe it should be possible, using my technology, to manufacture such spectacles inexpensively for mass use, so that populations in the developing world could, for example, obtain useful vision correction without the expensive infrastructure which is normally associated with the eyecare industry in the developed world” .

Following this interaction with Thylefors in 1994 I visited him on 31 January 1996 and he tried the “ cow ” eyeglasses I had made in 1993, found they worked for him, and suggested I should run a trial in the developing world. This led to a small trial in Ghana, paid for by the UK Government’s ODA , with a new and much more wearable better device. The results of that small trial were rather encouraging , and they were presented at the 6<sup>th</sup> General Assembly of IAPB in Beijing by George Afenyo and me, and a report of the work entitled Vision Correction with Adaptive Spectacles was published in World Blindness and its Prevention Vol 6 pp 201 – 208 , 2001. The first adaptive eyeglasses worn in Africa in this trial are now in the National Collection of the British Science Museum.

Following this small study Dr David Nabarro of ODA ( now DFID ) encouraged us to carry out a larger trial which was funded by DFID. This larger – though still quite small - trial was carried out with something over 200 subjects in four countries and investigated how well the adults in the trial could self-refract using adaptive eyeglasses which we called Adspecs. The results of the trial were presented at a Mopane meeting in South Africa in August 2003, and then published first as a meeting report in the South African Optometrist by Silver et al, S. Afr Optom 62 , 126 – 131 , 2003 , and later with some further detail by Douali and Silver in Ophthalmological and Physiological Optics 24 234 – 241 2004. This original work showed that the adults studied could self-refract rather well – something which was later confirmed in her Masters research by Kyla Smith from the New England College of Optometry, and published by Smith, Weissberg and Trivison in Optom Vis Sci 87 176 – 182 2010 .

Don Bundy has known about my interest in and work on self-refraction for rather a long time – ever since we were introduced by Michael Wills in the 1990’s, and Don has long taken the view that the approach could be helpful for children. As early as June 2003 I wrote to Don to ask for “World Bank Funding “ to “ research the application of a simple adaptive lens refractometer to child refraction in the developing world “ , pointing out that, “ Should this research prove successful, it is then likely to lead to a significant increase in the proportion of children whose refraction is accurately diagnosed, which in turn should then lead to many more children corrected. “ and going on to say “ This is bound to have a positive impact on education for the group of children ( approx 10% according to WHO ) who need vision correction and don’t have it. One of the collaborators I suggested to Don for this research was Leon Ellwein , with whom I had also been in a dialogue about refractive error, following our work with adults, and interestingly, Leon and I had agreed , when discussing some of the

data from the RESC study in April 2001, that “ it is possible that one would get a more accurate value for refraction on a child with an Adspec than with a non-cyclopegic auto-refraction, and that this MUST be researched - though amusingly, looking back, my notes from April 2001 say that Leon “ would collaborate in child vision work, but did not have any \$\$ to contribute “.

The dialogue with Don Bundy led to a meeting on Child Vision held at Wolfson College, Oxford in July 2007, and that meeting led to the so-called Child Self-Refraction Study – the results of which are to be presented at this meeting.

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