

ARC Centre of Excellence in Vision Science

MEDIA RELEASE

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PUPILS REVEAL SECRETS OF EYE DISEASE

An Australian scientific team has made important advances in a powerful new technique for quantifying damage caused by serious eye diseases affecting tens of millions of people worldwide.

Known as multifocal pupillography, the method involves monitoring minute responses of the eye's pupils to light signals in different parts of the patient's visual field.

Researchers at the ARC Vision Centre and Australian National University led by Drs. Ted Maddess and Andrew James are pioneering the use of multifocal pupillography for accurate and painless detection and monitoring of diseases such as glaucoma, age-related macular degeneration and diabetic retinopathy. Together these are thought to affect around 100 million people globally, aged 50 and over.

The technique relies on a feedback loop of nerve signals, which flow from each eye to the brain and back again to both pupils of the eyes by a secondary pathway, Dr Maddess explains.

"We've known for a century or so that the pupil reacts more to a stimulus on one side of the visual field than the other, though we did not know how or why until recently," he says. "In our research we have been trying to localise the responses of the pupil to particular places across the visual field and hence, the eye's retina."

By mapping places where the response of the retina is patchy and the pupil responds less strongly, the team are able to detect portions of the retina affected by disease and so improve the chances of early accurate diagnosis and treatment of a condition which, in many cases may result in loss of vision or complete blindness.

The technique used is to video the pupils in infra-red light and record the tiny contractions they make in response to stimuli in different parts of the visual field. This potentially offers a more accurate and earlier way to detect eye disease than techniques in use today, as well as a way to monitor the success of treatment, Dr Maddess says. By videoing the eyes, the researchers can also eliminate the problem of the patient blinking or glancing away during diagnosis by editing these actions out, which improves accuracy.

“The pupil’s most important function is to guarantee the optical quality of what you see. Quite why it twitches in response to stimuli in different parts of the visual field we are unsure – but it provides a very useful form of feedback about what is happening in the eye itself and in the nervous system behind it,” he says.

Possible disease can be detected by measuring a single pupil, but measuring both gives even greater confidence in the results. This comes about because each pupil responds to stimuli presented to either eye: both the direct response from its own eye and the “consensual” response of the other eye. “Mapping the consensual and direct responses at the same time gives us a clear impression of what is going on in the optical nervous system and brain. Differences in the ratio of responses can tell us about possible damage to a particular region of a single eye or particular parts of the brain.”

Thus, because it is measuring a signal both entering and leaving the brain the technique also holds considerable promise for improving the diagnosis of strokes and small tumours affecting the visual portion of the brain in a simple, non-invasive way, Dr Maddess says.

“Diabetic retinopathy affects three per cent of the population aged 50 and above, glaucoma affects two per cent and age-related macular degeneration affects another two, some of these problems rising to ten per cent in later life,” he explains. “All these conditions limit your independence and quality of life and add significantly to the national cost of aged care and healthcare.”

Almost half a million Australians suffer visual impairment in both eyes and rates of blindness are forecast to rise by 73 per cent over coming decades as the population ages. Costs of eye health care are tipped to more than double to \$3.7 billion by 2020. According to an Access Economics study (2004) blindness and cancer are the two conditions most feared by the population at large.

“Yet many eye diseases can be treated, easily and cheaply, especially if detected early and monitored well to be sure the treatment is working. Pupillography is showing great promise as a new technique for doing just that,” he says.

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