Egg Woos Sperm with Hormone

Scientists have made a breakthrough that creates the possibility of a contraceptive pill not based on hormones. They have tracked down the signal of ‘fertile attraction’ between egg and sperm. Laboratory experiments show a hormone released by an egg ready to be fertilised acts as a ‘come hither’ message to sperm – which then reacts in less than a second.

The discovery, reported in the science journal Nature, means it may be possible to develop non-hormonal contraceptives to turn the signal off, thus replacing the Pill. They found that when the sperm gets a boost of progesterone – a hormone released by cells surrounding the egg – the electric current increases in strength and their tails move faster.

This violent flicking of the sperm’s tail also gives it the ability to penetrate the egg, leading to fertilisation. Biologists have known for decades that egg cells provide sperm with a little chemical encouragement as part of the mating game, but the exact nature of the relationship has not been identified.

Dejian Ren, a physiologist at the University of Pennsylvania in Philadelphia, said: ‘This is one of the first times people have figured out at a molecular level how an egg signals to a sperm. ‘

And the discovery offers the chance to create non-hormonal birth control that prevents the egg wooing the sperm. The Pill works in women by using hormones to suppress ovulation – the release of an egg. As there is no egg to be fertilised, pregnancy cannot occur. Although current oral contraceptives are largely safe, they can raise the risk of certain cancers and cardiovascular disease. In previous research scientists have been investigating possible forms of male contraception using calcium channel blockers.

Without the influx of calcium ions, sperm lose energy and fail to penetrate an egg even when laid beside it.

The latest discovery could have potential for affecting the interaction between sperm and egg by modifying the calcium mechanism. This would not affect a man’s hormones – unlike forms of the male Pill. Dr Lishko said: ‘We’ve finally solved the question of what progesterone does to human sperm. It represents a promising target for the development of a new class of non-hormonal contraceptives.’

African Savanna Influenced Eye Evolution

On an African savanna 10 million years ago, our ancestors awoke to the sun rising over dry, rolling grasslands, vast skies, and patterned wildlife. This complex scenery influenced the evolution of our eyes, according to a new study, guiding the arrangement of light-sensitive cone cells. The findings might allow researchers to develop machines with more humanlike vision: efficient, accurate, and attuned to the natural world.

The human retina contains three types of light-sensitive cone cells—responding to red, green, or blue light—that are arranged in a mosaic pattern. This pattern isn’t random. Previous studies suggest that the retina adapts to an animal’s surroundings, evolving to extract the most information. For instance, the retinas of fish living at different depths of a lake have distinct patterns because they are attuned to detecting wavelengths of light filtered and distorted to varying degrees by the water. Physicist and lead author Gasper Tkačik of the University of Pennsylvania (Penn) calls this the “efficient coding hypothesis.”

Are human eyes also efficiently coded? They don’t seem to be. The sky and sea make up much of our natural scenes, yet only 6% of our cone cells detect blue, and they are mostly located around the edge of our retina. Of the remaining cones, the ratio of red to green cones varies wildly between individuals.

To find out why this is, Tkačik, along with neurobiologist Vijay Balasubramanian of Penn and colleagues, created a database of more than 5000 high-resolution photographs taken at various locations in Botswana, a place near where humans likely evolved and other primates still live. The same scenes were shot at different times of day, with different exposure lengths, apertures, and distances from the camera. Using an algorithm they developed from previous studies of how human cones detect light, the researchers calculated how many photons of different wavelengths the camera had captured and what cone arrangement would pick up the largest number of them.
The actual pattern of cones in the human retina matches the algorithm’s predictions, the researchers reveal in a paper uploaded to the arXiv database this month and another published in PLoS Computational Biology. Red and green cones would pick up more photons from the images than could blue cones. That explains why the eye makes so few blue cones and places them around the periphery of the retina rather than at the center, where light focuses, Balasubramanian says. Red and green cones, however, pick up about the same amount of information, so there’s no evolutionary benefit in keeping their ratio tightly regulated.

In addition to illuminating human eye evolution, the efficient coding hypothesis could help researchers develop robots that “see” as well as we do, the authors say. Currently, machine vision draws on a storehouse of images rather than actually translating color and patterns like human vision does. That creates problems when it has to recognize an object in an unfamiliar context. “We’re very far from really versatile machine vision,” says Tkačik.

The Botswana database will be useful as a standard for many researchers studying visual perception who are interested in contrast and shape recognition, not just color, says neuroscientist Matthias Bethge of the Werner Reichardt Centre for Integrative Neuroscience in Tübingen, Germany. Whether images from Africa would give very different results from images in another part of the world isn’t certain; he points out that human vision works just as well even in outer space. Balasubramanian says that future research may address this question of whether human eyes in different environments have adapted differently.

### Lethal Red Tape

Unethical regulations which delay emergency treatment can kill. Current rules requiring researchers to obtain consent for patients to take part in clinical trials in emergency situations are causing life-threatening delays to treatment, experts have argued.

They say that in severe trauma cases, waiting for a relative to give written permission is ‘unethical’ because of the importance of prompt treatment. Professor Ian Roberts, Dr Haleema Shakur and Dr David Prieto-Merino, from the Clinical Trials Unit of the London School of Hygiene & Tropical Medicine, make their point in a letter published in The Lancet.

It is co-signed by Sir Iain Chalmers, of the James Lind Initiative in Oxford, and Professor Jon Nicholl, from the University of Sheffield. The researchers analysed data from a large international clinical trial in severe head injury and found that initiation of treatment is delayed by over an hour where written consent from relatives is required. But when early treatment is vital – such as in the case of tranexamic acid for severe internal bleeding – this delay can prevent patients from benefiting and increase their risk of death. The authors argue that about one sixth of patients in the CRASH-2 trial missed out on the chance to benefit from a life-saving treatment because of unethical application of what they call “consent rituals”.

“The need for urgent treatment, even in patients who are conscious and whose relatives are available, excludes the possibility of fully informed consent,” the letter states. “If consent rituals delay the start of a trial treatment such that the treatment effect could be reduced or obscured, we maintain that seeking consent is actually unethical.” It adds: “Informed consent procedures, like other well-intentioned public health interventions, should be assessed rigorously. “The lethal effects we have shown might have been found decades ago had the research ethics community accepted a responsibility to provide robust evidence that its prescriptions are likely to do more good than harm.”

### World’s First Practical Artificial Leaf

Scientists have claimed one of the milestones in the drive for sustainable energy -- development of the first practical artificial leaf. Speaking in Anaheim, California at the 241st National Meeting of the American Chemical Society, they described an advanced solar cell the size of a poker card that mimics the process, called photosynthesis, that green plants use to convert sunlight and water into energy.

“A practical artificial leaf has been one of the Holy Grails of science for decades,” said Daniel Nocera, Ph.D., who led the research team. “We believe we have done it. The artificial leaf shows particular promise as an inexpensive source of electricity for homes of the poor in developing countries. Our goal is to make each home its own power station,” he said. “One can envision villages in India and Africa not long from now purchasing an affordable basic power system based on this technology.”

The device bears no resemblance to Mother Nature’s counterparts on oaks, maples and other green plants, which scientists have used as the model for their efforts to develop this new genre of solar cells. About the shape of a poker card but thinner, the device is fashioned from silicon, electronics and catalysts, substances that accelerate chemical reactions that otherwise would not occur, or would run slowly. Placed in a single gallon of water in a bright sunlight, the