

# Scientists discover gene regulation mechanism unique to primates

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Scientists have discovered a new way genes are regulated that is unique to primates, including humans and monkeys. Though the human genome – all the genes that an individual possesses – was sequenced 10 years ago, greater understanding of how genes function and are regulated is needed to make advances in medicine, including changing the way we diagnose, treat and prevent a wide range of diseases.

"It's extremely valuable that we've sequenced a large bulk of the human genome, but sequence without function doesn't get us very far, which is why our finding is so important," said Lynne E. Maquat, Ph.D., lead author of the new study published today in the journal *Nature*.

When our genes go awry, many diseases, such as cancer, Alzheimer's and cystic fibrosis can result. The study introduces a unique regulatory mechanism that could prove to be a valuable treatment target as researchers seek to manipulate gene expression – the conversion of genetic information into proteins that make up the body and perform most life functions – to improve human health.

The newly identified mechanism involves Alu elements, repetitive DNA elements that spread throughout the [genome](#) as [primates](#) evolved. While scientists have known about the existence of Alu elements for many years, their function, if any, was largely unknown.

Maquat discovered that Alu elements team up with molecules called long noncoding RNAs (lncRNAs) to regulate protein production. They do this

by ensuring messenger RNAs (mRNAs), which take genetic instructions from DNA and use it to create proteins, stay on track and create the right number of proteins. If left unchecked, protein production can spiral out of control, leading to the proliferation or multiplication of cells, which is characteristic of diseases such as cancer.

"Previously, no one knew what Alu elements and long noncoding RNAs did, whether they were junk or if they had any purpose. Now, we've shown that they actually have important roles in regulating protein production," said Maquat, the J. Lowell Orbison Chair, professor of Biochemistry and Biophysics and director of the Center for RNA Biology at the University of Rochester Medical Center.

The expression of genes that call for the development of proteins involves numerous steps, all of which are required to occur in a precise order to achieve the appropriate timing and amount of protein production. Each of these steps is regulated, and the pathway discovered is one of only a few pathways known to regulate mRNAs directly in the midst of the protein production process.

Regulating mRNAs is one of several ways cells control gene expression, and researchers from institutions and companies around the world are honing in on this regulatory landscape in search of new ways to manage and treat disease.

According to Maquat, "This new mechanism is really a surprise. We continue to be amazed by all the different ways mRNAs can be regulated."

Maquat and the study's first author, Chenguang Gong, a graduate student in the Department of Biochemistry and Biophysics at the Medical Center, found that long noncoding RNAs and Alu elements work together to trigger a process known as SMD (Staufen 1-mediated mRNA

decay). SMD conditionally destroys mRNAs after they orchestrate the production of a certain amount of proteins, preventing the creation of excessive, unwanted proteins in the body that can disrupt normal processes and initiate disease.

Specifically, long noncoding RNAs and Alu elements recruit the protein Staufen-1 to bind to numerous mRNAs. Once an mRNA finishes directing a round of [protein production](#), Staufen-1 works with another regulatory protein previously identified by Maquat, UPF1, to initiate the degradation or decay of the mRNA so that it cannot create any more proteins.

While the research fills in a piece of the puzzle as to how our [genes](#) operate, it also accentuates the overwhelming complexity of how our DNA shapes us and the many known and unknown players involved. Maquat and Gong plan on exploring the newly identified pathway in future research.

Provided by University of Rochester

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