# Investigating Amblyopia: How “Lazy Eye” Affects Visual Brain Circuits

## Introduction

Amblyopia—often referred to as “lazy eye”—is a developmental vision disorder affecting around three percent of the global population. It occurs when one eye does not communicate effectively with the brain, leading to reduced vision that cannot be fully corrected with glasses or contact lenses. Although many amblyopic individuals receive treatments like corrective lenses or eye patching, they are often not sufficient to correct all the visual deficits. These deficits are tied to how the brain processes and interprets visual signals, rather than to a simple problem in the eye itself.

## A Closer Look at Visual Pathways

Within the visual cortex—the brain’s primary processing center for sight—two key pathways interact to make sense of the images our eyes capture:

1. *Feedforward Pathway:* Visual information travels from our eyes to our visual cortex, telling us what is out there.
2. *Feedback Pathway:* Visual information travels from higher brain areas to our visual cortex, telling us what we think is out there. This pathway helps the brain to interpret the visual information from our eyes, for example when something obstructs the view.

It has been shown that amblyopic patients take more time to detect illusory contours, and tend to search them with their eyes, instead of seeing them as a whole. That is consistent with our hypothesis, that feedback pathway is more affected by amblyopia than feedforward one.

## Our Approach

Our project explores how these pathways are altered by amblyopia. First, we use advanced imaging techniques in mice to measure both feedforward and feedback activity in the visual cortex. We compare normal mice to mice with induced amblyopia, looking at cortex activity both across individual brain cells and on a larger scale. By confirming which pathway is more affected by amblyopia at a large scale, we can then apply the same principles in human studies. Using non-invasive imaging tools like functional MRI, we aim to see if human amblyopic patients show a similar imbalance between feedforward and feedback processing.

## Potential Impact

By pinpointing which visual pathways in the brain are more affected by amblyopia, our work could lead to targeted therapies that strengthen or restore feedback signals. This knowledge may pave the way for new treatments—ranging from perceptual training exercises to medication-based strategies—that help the amblyopic brain in interpreting the world. Ultimately, we hope our findings will improve outcomes for children and adults living with amblyopia and offer a clearer path toward preserving and enhancing their vision.