Recalculating cell sensing: Mobile cells are more sensitive than once thought

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Mobile biological cells may be twice as good at following chemical signals as previously believed possible, according to Princeton researchers publishing in the latest issue of *Physical Review Letters*. The revelation offers new insight into the ability of microscopic, single-celled entities such as bacteria, amoebae, immune cells and sperm to find their way to their intended destinations.

Biological sensors, including the retina in our eyes, typically evolve to operate very nearly at the ultimate limits allowed by physics. The main things that prevent them from achieving absolute perfection are random fluctuations known as noise. Determining the amount of noise inherent to a cell's detection scheme lets biologists know how well a cell can respond to a signal. In the case of microscopic cells and creatures that follow chemical trails, organisms have two tracking methods at their disposal.

For larger microorganisms like amoeba, the relative amount of a chemical on one side of the cell compared to the other side indicates which direction to travel in order to move to higher concentrations of desirable chemicals. Smaller cells, like those of the bacterium E. coli, instead monitor changes in the total chemical concentration, and they find their way by moving in the direction that increases the overall signal of chemicals they find appealing.

For the last thirty years, researchers have believed they had a good handle on the noise that chemical-sensing cells were faced with, but the

new analysis shows that the noise may be low enough for some cells to do twice as well at following chemicals as long-standing estimates suggested. More research will be necessary in order to tell if cells are as sensitive to chemical signals as the recent study proposes. In any case, the work should help guide scientists who are developing synthetic sensors modeled on cells that follow chemical trails.

Sima Setayeshgar of Indiana University offers an overview of chemical sensing in cells, and a look at old and new estimates of their sensitivity limits, in a Viewpoint article in the current issue of *APS Physics*.

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