to and make use of numbers—not just in the form of symbols and words, but as quantities of objects, of events, and of abstract concepts. Butterworth is one of several researchers who believe that the human brain can be thought of as having a “sense” for number, and that we, like our evolutionary ancestors, are neurologically hardwired to perceive all sorts of quantities in our environment, whether that serves for selecting the bush with more fruit on it, recognizing when a few predators on the horizon become too many, or telling from a show of hands when a consensus has been reached.

Indeed, that most humans, even from a very early age, can quickly and accurately distinguish among different quantities of things is so obvious that it’s frequently taken for granted. This ability, known as numerosity perception, is distinct from counting—the process of keeping a tally while going through a set of objects—and is present in infants long before they learn words or symbols for particular numbers. It is evident, too, among adults in isolated human populations that typically don’t use numbers much in their daily lives. Moreover, it’s not human-specific: experiments with monkeys, crows, fish, and even bees indicate that numerosity perception, at least for relatively small quantities, is widely distributed across the animal kingdom. (See sidebar on page 75.)

How numerosity perception works neurologically, and how important it is in human cognition, are tougher questions to answer, and ones that have sparked debate among researchers. While some scientists propose that the so-called sense of number is an independent phenomenon, something that gives a special meaning to “four” and “five” as discrete quantities. Some scientists assign this number sense an even greater importance, claiming that it’s the foundation for humans’ capacity for numerical reasoning and arithmetic—that there is a connection between our ability to quickly recognize the number of flowers in a vase, and our ability to understand why 2 + 4 = 6.

Nursery rhymes have carried single-cell recordings in the brains of macaques, among other animals. In a series of experiments, Nieder’s team demonstrated that certain neurons in the intraparietal sulcus (IPS) and the prefrontal cortex (PFC)—parts of the brain that have been implicated in visual attention and higher cognitive processes, respectively—respond selectively to particular quantities of objects. The findings hint at the existence of dedicated “number neurons” that extract numerical information from sensory input. Some researchers propose that these number neurons actually lie downstream of a separate number-extracting system in the visual cortex, while others dispute the idea of a dedicated number-sensing system in the brain at all. More research is needed—in humans as well as in animals—to get to the bottom of how brains perceive and process numerical quantity, or numerosity.