A simple *mathematical* argument explains why children suddenly learn lots of new words

1.   References:

Section: Calculating the Word Spurt

When children first begin to talk, they learn perhaps a word or two a week. Then suddenly, at around 14 to 18 months, they seem to soak up new words like a sponge, learning as many as ten a day.

Child psychologists have long been puzzled by this dramatic acceleration, and they have developed a variety of theories to explain it. Some researchers have argued that as the brain develops, it reorganizes to become much more efficient at storing new words. Others have argued that babies are able to use their knowledge of a few words to deduce the meanings of other words.

Bob McMurray, a child psychologist at the University of Iowa in Iowa City, now says that a bit of mathematics is enough to explain the phenomenon. Children's word absorption, he says, is the logical consequence of two basic principles: (1.) children work on learning many words at the same time, and (2.) some words are more difficult to learn than others.

McMurray created a simple ***mathematical model*** that assigned point scores to words based on how difficult they are to learn. A word like "mommy," for example, might be assigned just one point, whereas a word like "elephant" might get 10 and a word like "aptitude" might get 100.

For purposes of the ***model***, he assumed that children are regularly exposed to all the words they learn and that the higher a word's point score, the more times a baby will have to hear the word to learn it. So kids will learn "mommy" quickly, but a rarely used and more abstract word such as "aptitude" may come much later.

McMurray notes that languages have only a small number of very easy-to-learn words and many more intermediate words. So when a baby has been exposed to enough language to learn the easy words, she will acquire just a few words. As she is exposed to more language, she begins to learn the medium words. And because there are a lot of medium words, she is likely to pick up a lot of words at this stage. This, McMurray says, is the vocabulary explosion.

"It shows how computation can illustrate some very complex implications of really simple theories," McMurray says.

McMurray notes that because researchers don't know exactly what factors make a word easy or hard to learn, it's difficult to pin down the number of hard and easy words in a language.

As a first approximation, he assumed that a word is more difficult the less frequently it appears in written language or in mothers' speech to their children--statistics that are both readily available. He then noted that many other factors must influence difficulty, such as the part of speech, the complexity of the sound pattern, and whether the word's meaning is concrete or abstract. Putting all of these factors together, he came up with a roughly bell-shaped distribution with fewer easy and hard words than intermediate words. That distribution, plugged into McMurray's ***model*** of learning, naturally produced a rapid rise in rate of words learned following a relatively slow start.

"The explanation lies in the mathematics of learning," McMurray says.

Jennifer Ganger, a child psychologist at the University of Pittsburgh, says other psychologists have argued that children may not undergo a word spurt at all, and that if they do, it isn't caused by any significant cognitive change. But McMurray's argument that the word spurt is caused by a single learning mechanism, working at the same rate throughout development, is novel. "This is important," she says, "because too much energy has been wasted trying to understand the causes of the spurt."

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A new ***mathematical*** theory explains toddlers' "word spurt." Photodisc

In McMurray's **model**, the rate of word acquisition is initially slow but increases rapidly. McMurray

References:

McMurray, B. 2007. Defusing the childhood vocabulary explosion. Science 317(Aug. 3):631. Abstract available at http://www.sciencemag.org/cgi/content/abstract/317/5838/631.

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