In the last lecture, we looked at theories of object recognition. In this lecture, I'll discuss how words are recognized. The first step in identifying words is to identify the letters that comprise them. However, that is even a very difficult task.

Letter identification poses many of the same problems as object recognition does. Recall that objects have u-invariant properties. That is, objects can be identified from an infinite number of perspectives.

Letters are like that, too. We can identify letters in a variety of different fonts or handwriting. What this means is that we can easily reject any theory that assumes that we have a set of 26 templates in mind to which we compare letters while reading.

You will also recall the debate over language was instrumental in bringing on the cognitive revolution in psychology. Not surprisingly, therefore, is that some of the earliest cognitive models concern language. Here's a depiction of one of the earliest cognitive models developed by Selfridge to explain how we identify letters. It's called the Pandemonium model.

Information in this module flows in one direction, from the bottom up. Each layer of the model is comprised of demons that respond by jumping up and down when activated. The more they are activated, the more they jump up and down. Each demon corresponds to some aspect of the letter. At the feature level, the demons represent the lines and curves that comprise letters.

In this example, the letter A is the stimulus. And three featured demons are activated. Now this is very much like what initially occurs in the visual cortex. It's really cool to note that this module was proposed at the very same time that Hubel and Wiesel were making their discoveries about how the visual cortex works.

Note, too, just like the brain, that the higher-level demons begin to put together the line segments, in order to represent letters and identify them. The more letter features that a cognitive demon shares with the stimulus, the greater its activation. Finally, a decision demon decides which of the cognitive demons is most active. This is very much like what we now think occurs in the ventral what pathway of visual processing.

The Interactive Activation model was developed by Rumelhart and McClelland to explain how letters are combined to identify words. According to this module, there are three levels, the feature level, the letter level, and the word level. Like the Pandemonium model, the more features shared by a letter node in the stimulus, the greater the letter node's activation.

The model assumes that there is a set of letter nodes for each letter in a word. As the eyes move from left to right,

each of the corresponding letter nodes are activated. And they activate the appropriate word node.

However, unlike the Pandemonium model, which is entirely bottom-up, the Interactive Activation model is also a top-down model. What happens is that the higher-level nodes inhibit the activation of lower-level nodes but do not contribute features to the higher-level node. So for instance, the word fork node would inhibit letter level nodes corresponding to J, L, et cetera.

The top-down processing of the Interactive Activation model allows it to explain the Word Superiority Effect discovered by Reicher in 1969. The task in this experiment was a name or identify a briefly-flashed letter. There were three conditions in the experiment.

In the first condition, a word was flashed. And the subject was instructed to name one letter that occupied a certain position on the display. In this example, the subject was to choose among the K and the M alternatives. Note, both K and M can be used to form a legal word from the set F-O-R.

In the second condition, a letter was flashed in one of the four positions by itself. In the third condition, a scrambled, non-word was flashed. The dependent variable in this experiment was percent correct.

Now you might think it would be easier to identify a single flash letter when only one letter was flashed. But in fact, letters were identified better when they are flashed in the context of a word. According to the Interactive Activation model, this is because the incorrect alternative is inhibited by the activation of the word-level node associated with the stimulus.

Study Guide 1, true or false? Letter identification poses many of the same problems as object identification. The answer is true. Letters come in many forms and fonts. And it's easy for us to identify them, even if we've never seen this form of letter before.

True or false? Unlike objects, letters do not have invariant properties. The answer is false.

True or false? Early models of letter identification were disconfirmed by neuroscientific research on vision. The answer is false. Selfridge's Pandemonium model was very similar to the theories of Hubel and Wiesel.

True or false? The key to predicting the Word Superiority Effect is to assume that bottom-up processing inhibits word-level nodes. The answer is false. The key to predicting the Word Superiority Effect is to assume the top-down processing inhibits letter-level modes.