one's own experience. An alternative explanation is the *direct-matching hypothesis*, the idea that observation of the actions of others activates motor circuits in the observer that control similar motor actions. According to this hypothesis, empathetic activation of motor circuits could provide a link between the observed actions and the observer's stored knowledge of the nature, motives, and consequences of similar actions that they had performed in the past.

Striking evidence in support of the direct-matching hypothesis was provided by the discovery of a remarkable population of neurons called mirror neurons, first in PMv and later in the parietal AIP of monkeys. Mirror neurons discharge both when the monkey actively grasps and manipulates objects and when it observes similar actions performed by another monkey or the experimenter (Figure 34–14). Mirror neurons typically do not respond when a monkey simply observes a potential target object or when it observes mimed arm and hand actions without a target object. Some parietal mirror neurons can even differentiate the ultimate goal of similar observed actions, such as grasping and picking up food to eat it versus putting it into a cup.

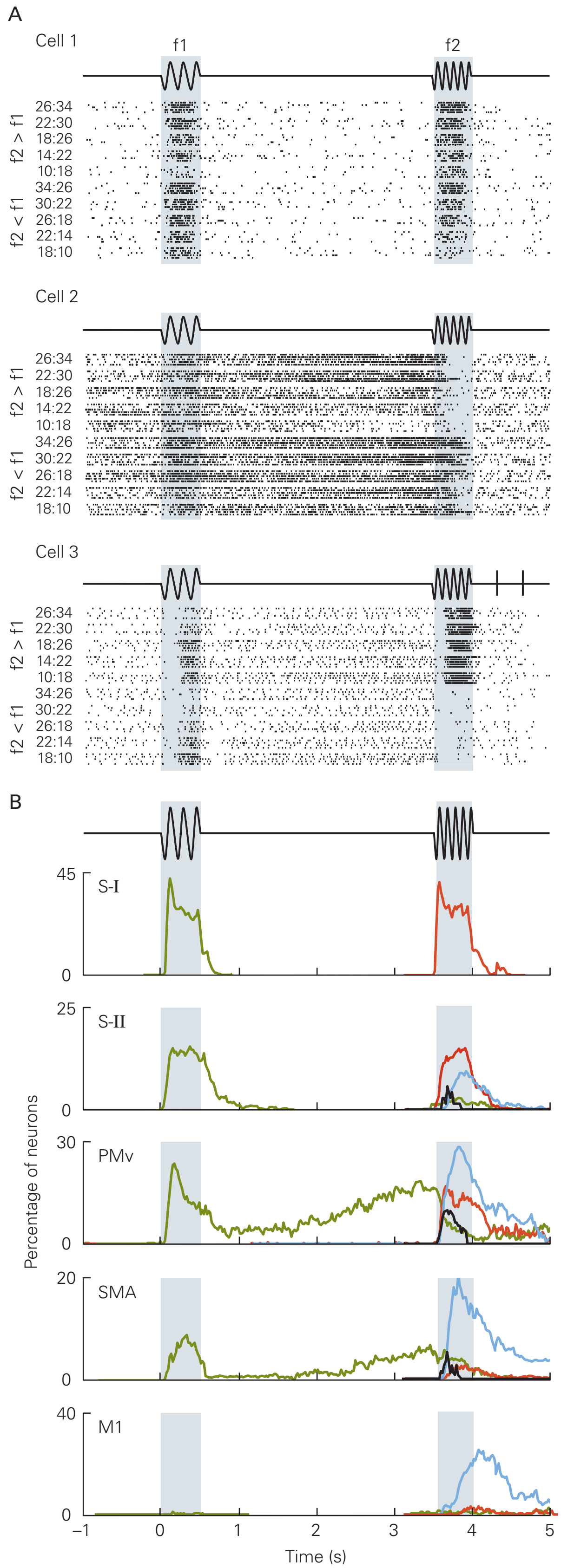

Figure 34–13 (Right) **Neural activity in ventral premotor cortex in monkeys expresses the operations required to choose a motor response based on sensory information.** (Adapted, with permission, from Romo, Hernández, and Zainos 2004. Copyright © 2004 Cell Press.)

A. These records of three neurons in the ventral premotor cortex of a monkey were made while the animal performed a task in which it had to decide whether the second of two vibration stimuli (**f1** and **f2**, applied to the index finger of one hand) was of higher or lower frequency than the first. The choice was signaled by pushing one of two buttons with the nonstimulated hand. The frequencies of f1 and f2 are indicated by the numbers on the left of each set of raster plots. Cell 1 encoded the frequencies of both f1 and f2 while the stimuli were being presented but was not active at any other time. This response profile resembles that of many neurons in the primary somatosensory cortex. Cell 2 encoded the frequency of f1 and sustained its response during the delay period. During the presentation of f2, the neuron's response was enhanced when f1 was higher than f2 and suppressed when it was lower. Cell 3 responded to f1 during stimulation and was weakly active during the delay period. However, during exposure to f2, the cell's activity robustly signaled the difference f2–f1 independently of the specific frequencies f1 and f2.

B. Histograms show the percentage of neurons in different cortical areas whose activity correlated at each instant with different parameters during the tactile discrimination task. **Green** shows the correlation with f1, **red** the correlation with f2, **black** the interaction between f1and f2, and **blue** the correlation with the difference between f2–f1. (Abbreviations: **M1**, primary motor cortex; **PMv**, ventral premotor cortex; **S-I**, primary somatosensory cortex; **S-II**, secondary somatosensory cortex; **SMA**, supplementary motor area.)