Chapter selection from: Rachlin, H. (1970) Introduction to Modern Behaviorism. San Francisco: Freeman.

There has been little laboratory research on self-control, but a recent experiment by George Ainslie at Harvard University has shown self-control of the "remote alarm clock" variety exhibited by pigeons. The pigeons in Ainslee's experiment were deprived of food until they weighed about 80 percent of what they would if they were allowed to eat freely. Then they were put into a chamber with a single key, on which they could peck, and a food hopper. The key was dark ordinarily, but every once in a while, it would be illuminated with red light for 2.5 seconds. If the pigeons pecked the key during the 2.5 seconds that the key was red, the food hopper would be available immediately for 1.5 seconds. If the pigeons refrained from pecking the key for the 2.5 seconds that the key was red, they would receive 4 seconds of access to the food without pecking for it. Now pigeons normally show strong preference for a 4-second reward over a 1.5-second reward. Yet, in this experiment all the pigeons pecked the key as soon as it turned red. The pigeons seemed to prefer a 1.5-second reward immediately to a 4-second reward that they would have to wait a short time for. In other words, they could not control their tendency to peck for an immediate reinforcement even though the long-term reinforcement for not pecking was greater. After observing this behavior Ainslie introduced a new contingency to the experiment. About eleven seconds before the key turned red, it would turn white. If the pigeons pecked the key when it was white, they would prevent the key from turning red when it ordinarily would have and they would obtain the 4-second reward at the end of the trial. In a sense, pecking the white key was like putting the alarm clock far from the bed. It insured that the larger reward would be obtained. If the pigeon did not

peck the white key, the key would turn red and a peck on the red key would produce an immediate 1.5-second reward as before. Figure 5.1 diagrams the experimental procedure. A peck on the white key could not affect reward directly. It could only prevent the opportunity to make a choice later between a small immediate reward and a larger delayed reward. Ainslie's pigeons exhibited self-control. They pecked the white key about 90 percent of the time it was offered to them. Later, in a

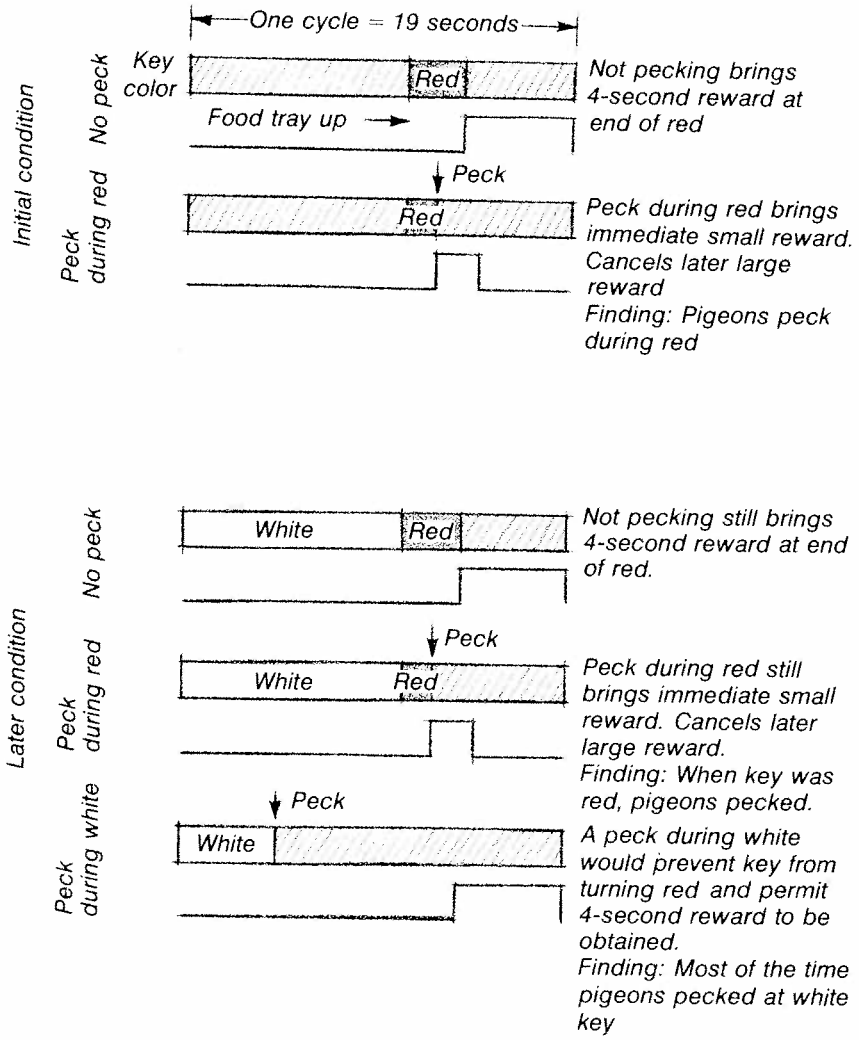

Figure 5.1 *A diagram of Ainslie's experiment, showing self-control by pigeons.*

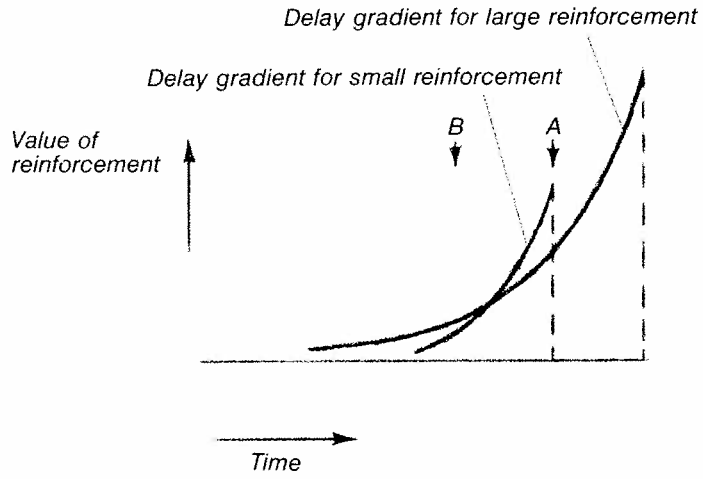

Figure 5.2 *Delay gradients. Reinforcements will be delivered at times indicated by vertical dotted lines. Prior to point of delivery, reinforcement is "discounted"—the further in the future reinforcement is to be, the less it is worth. A and B are points at which a choice must be made between the large reinforcement and the small reinforcement.*

control experiment, Ainslie allowed the key to turn red no matter what the pigeons did while the key was white. Here, the pigeons stopped pecking the white key (but continued to peck the red key).

It is possible to explain Ainslie's results in terms of *gradients* of delay of reinforcement. Figure 5.2 shows two gradients, one for the short reinforcement and one for the long reinforcement. Each gradient is highest at the point of reinforcement. The further away reinforcement is, the lower the gradient. At Point A, when the red light comes on the small reinforcement gradient is available immediately and is at its maximum. The larger reinforcement is still a few seconds away, and its gradient is low at Point A. At Point B, on the other hand, both reinforcements are far in the future, hence both are low. Because of the particular shape of the gradients, they cross so that one gradient is higher at Point A and the other is higher at Point B. The pigeons are said to chose according to whichever gradient is higher. At Point A (when the key is red) the gradient for the immediate reinforcement is higher. At Point B (when the key is white) the gradient for the delayed reinforcement is higher. The fact remains, however, that behavior at Point B, when the key is white, has no direct effect on reinforcement. Rather it affects behavior which, in turn, affects reinforcement. This is a characteristic of situations in everyday life that we would call examples of self-control.